WAR MACHINE

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WAR MACHINE

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Soviet Naval Infantry

US Amphibian Development

Amphibious Vehicles in Vietnam

Armed Forces of the World: British Army (Part 1)

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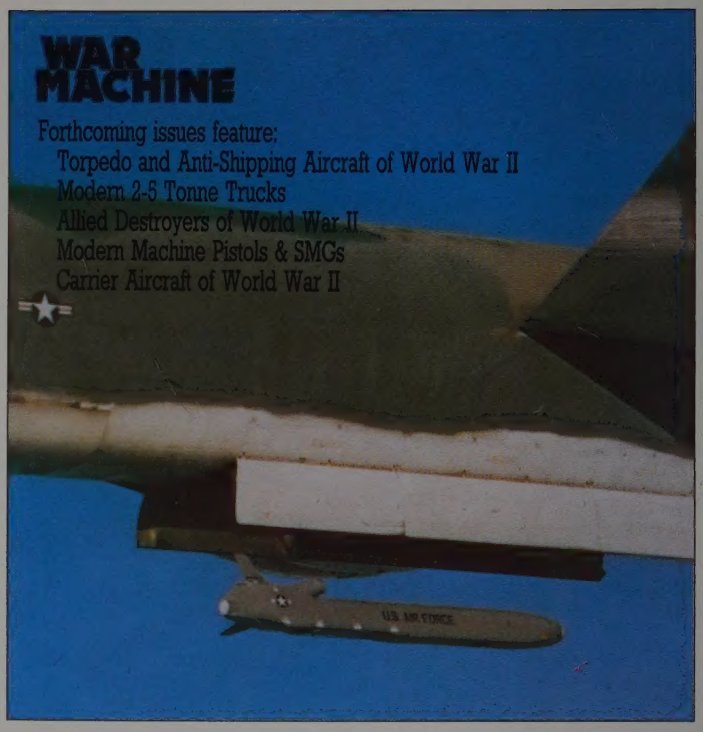

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Modern Amphibious and Oversnow Vehicles

For centuries, two of the many problems facing the practitioners of warfare have been water and winter. In this century of total war, it is natural that efforts should have been made to overcome the difficulty.

Typical of most of the amphibious cargo carriers currently in production, the Pegaso VAP 3550/1 is based on a 4×4 truck to which has been fitted a boat-shaped hull. It is driven by waterjets at up to 5.5 kts while afloat, and can climb a 60 per cent gradient.

Amphibious vehicles of one type or another played a significant role with the Allies during World War II, especially in the invasion of Italy, the Normandy campaign, the crossing of the Rhine and the recapture of the Netherlands. Moreover, the countless amphibious operations in the Far East could not have been successfully carried out without the tracked amphibious vehicles commonly known as the Amtracks.

In the post-war period the US Marine Corps kept the art of amphibious warfare alive, and today the USA has the largest amphibious force of any country in the world. The modern US Marine is not only taken ashore in the latest LVTP7A1, but also by landing craft, helicopters and air-cushion vehicles. This gives the commander many more options than in the past as not only can he land troops and equipment on the beaches, but the helicopters also allow him to move men and supplies quickly inland. The 4x4 LARC (Lighter Amphibious Resupply Cargo) carries the cargo from the ships offshore onto the beaches, but in the future its role will be carried out much quicker by the hovercraft.

Many other countries have small marine units, normally under the operational control of the navy, and some of these in the Western sphere have small numbers of the LVTP7 armoured amphibious vehicle.

The Soviet marines have been receiving much new equipment in recent years although, with under 15,000 men, this Naval Infantry force does not yet have the same sustained power-projection role as the US Marine Corps. The Soviets have, however, made far more use of hovercraft in recent years than the Americans, and this vehicle type would prove to be very useful in the Baltic area in times of crisis. The Soviet army maintains many amphibious vehicles for operations in Europe.

Oversnow vehicles are used mainly by the USA in Alaska, the Scandinavian countries (Sweden, Norway and Finland), and of course the Soviet Union. In the West the Swedish company Hägglund and Söner leads in the design, development and production of tracked oversnow vehicles, and its new Bv 206 has already been selected by the USA as its standard vehicle of this type. Other NATO countries, including the UK, maintain specialized units to reinforce Norway in time of war, and these units have Bv 202 tracked oversnow vehicles, to be replaced by Bv 206s in the future.

Primary exponents of amphibious warfare, the US Marine Corps may make an assault in helicopters, air cushion vehicles, landing craft, or in the LVT7 (Landing Vehicle Tracked) series of armoured amphibians. No other nation has any comparable capability.

ITALY

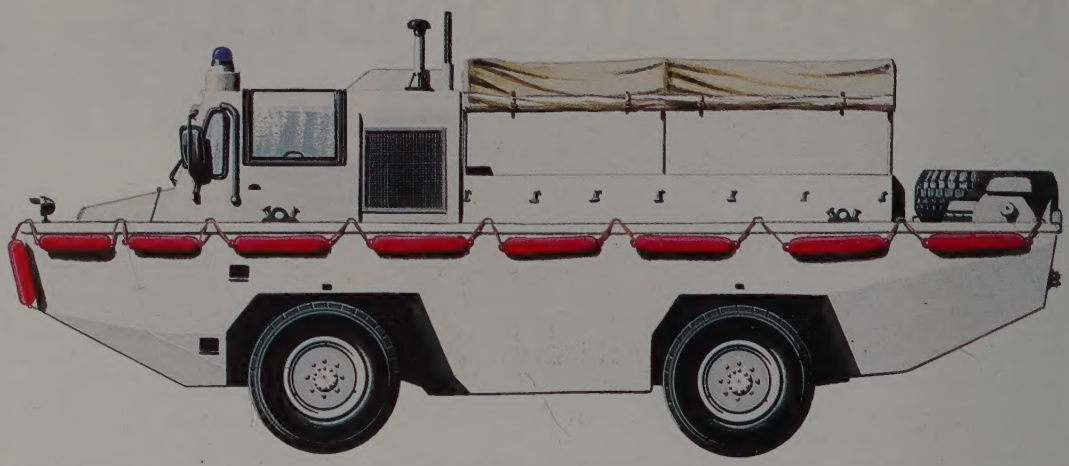
FIAT Type 6640A amphibious vehicle

FIAT is the largest manufacturer of wheeled military vehicles in Italy, and it was natural that when the Italian Home Office Civil Protection and Fire Fighting Department issued a requirement for an amphibious vehicle some years ago that FIAT should tender a vehicle. This entered production under the designation **FIAT Model 6640A**, and can carry a maximum payload on land or water of 2140 kg (4,718 lb).

The hull of the FIAT Model 6640A is of all-welded aluminium construction with a maximum thickness of 4 mm (0.16 in), and is divided into three compartments: engine at the front, crew in the centre and freight at the rear. The engine is coupled to a manual gearbox with five forward and one reverse gear and a torque converter. The suspension, front and rear, consists of an independent strut and link with helical spring and rubber bump stop, with a hydraulic shock absorber. Steering is power-assisted, and on land the vehicle has a turning radius of 7.5 m (24.6 ft).

The crew compartment in the centre is provided with windows and side-screens, and this and the load compartment to the rear can be covered by bows and a tarpaulin cover. When afloat the vehicle can be powered by its wheels or a four-blade screw type propeller with a Kort nozzle, steering being accomplished by a rudder coupled to the steering wheel. Mounted at the front of the vehicle is a winch with a maximum capacity of 3000 kg (6,614 lb). Three bilge pumps are provided as standard, one in the engine compartment (separated from the crew compartment by a fireproof bulkhead) and another two under the cargo area.

Production of the FIAT Model 6640A has now been completed, but further development has resulted in the **FIAT Type 6640G** which was announced in 1980 and, according to FIAT, is not in production. The main difference between this and the earlier vehicle is the Type 6640G's longer wheelbase and more powerful engine, the latter developing 195 hp (145 kW) and coupled to a fully automatic gearbox with three forward and one reverse gear. The cab is now fully enclosed and provided with a heater, and the vehicle is propelled in the water by a single waterjet under the hull rear.



The aluminium-hulled Type 6640A is in paramilitary service with the Italian home office, used for civil protection and also in the fire service.

The Type 6640A has a cargo capacity of some 3000 kg (6,614 lb) capable of 90 km/h (56 mph) on land; on water it can be manoeuvred by wheels or by a propeller. As with many modern amphibians, the vehicle bears a resemblance to the pioneering American DUKW of World War II.

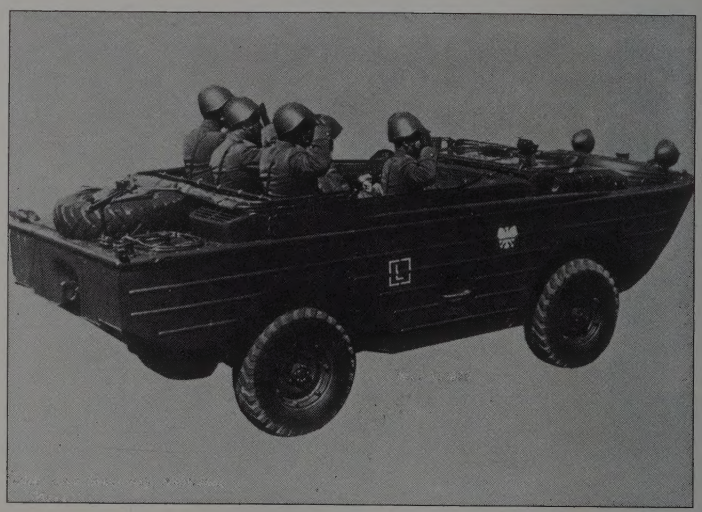
Specification
FIAT Type 6640A
Crew: 1+1
Combat weight: 6950 kg (15,322 lb)
Powerplant: one FIAT Model 8060.02 6-cylinder diesel developing 117 hp (87 kW)
Dimensions: length 7.30 m (23 ft 11.4 in); width 2.50 m (8 ft 2.4 in); height overall 2.715 m (8 ft 10.9 in)
Performance: maximum road speed 90 km/h (56 mph); maximum water speed with propeller 11 km/h (6.8 mph) or with wheels 5 km/h (3.1 mph); range on land 750 km (466 miles); range on water with propeller 60 km (37 miles) or with wheels 30 km (18 miles); fording amphibious; gradient 50 per cent; trench not applicable; vertical obstacle 0.43 m (1 ft 5 in)

USSR

GAZ-46 MAV amphibious vehicle

During World War II Canada, the UK and the USA shipped vast quantities of military equipment to the Soviet Union, including Ford GPA 4×4 amphibious jeeps and DUKW 6×6 amphibious load-carriers. These were used to ferry men, equipment and supplies across the many rivers in eastern Europe during the push back into Germany. After the end of the war the Soviet Union decided to design two similar vehicles, the **GAZ-46 MAV** being the equivalent of the Ford GPA and the BAV 485 the equivalent of the DUKW. Initial production GAZ-46 vehicles were built on the GAZ-67B 4×4 chassis which was produced during World War II, while later production vehicles were based on the post-war GAZ-69 4×4 500-kg (1,102-lb) light vehicle, which entered production at the Gorki plant in 1952. The main role of the GAZ-46 MAV, apart from its basic role of transporting men and light supplies across rivers and lakes, was in river reconnaissance, but from the late 1950s this role was taken over by the much more capable BRDM-1 4×4 amphibious scout car. In the 1950s the East Germans produced a not dissimilar 4×4 light vehicle for their army under the designation P2M and subsequently developed an amphibious version of this under the designation **P2S**. This was not produced in large numbers and is no longer in service. The P2M was replaced in production by the P3 but the amphibious version of this vehicle did not enter production.

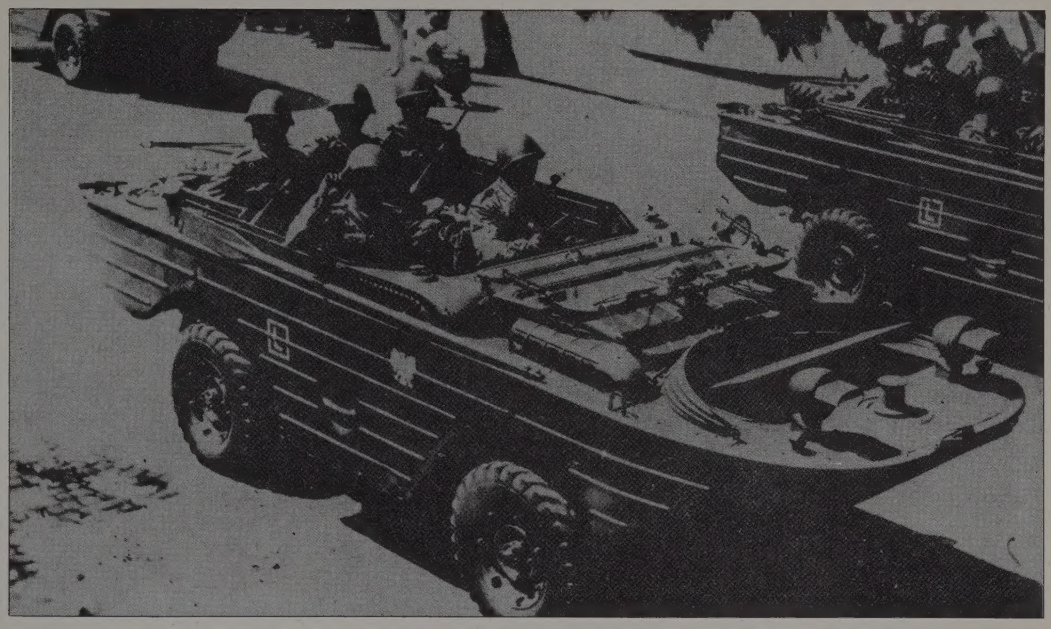
The hull of the GAZ-46 MAV is of all-steel construction with the engine compartment at the very front, the passenger area in the centre, and a spare wheel and tyre carried horizontally on the rear deck. The driver and vehicle commander have individual seats and to their rear is a three-man bench seat. The windscreen can be folded down onto the bonnet, and if required a tarpaulin cover can be erected over the crew area. The engine is coupled to a manual gearbox with three forward and one reverse gear and a two-speed transfer case. The vehicle is powered in the water by a single three-blade propeller mounted under the very rear of the hull and driven from the main engine; before the vehicle enters the water a trim vane is erected at the front to stop water swamping the en-



American aid to the Soviet Union during World War II included large numbers of amphibious trucks, which were of such value that the Red Army copied the concept post-war; the 4×4 GAZ-46 MAV amphibious truck appeared in the late 1940s.

gine and crew compartments. The vehicle has a maximum payload of 500 kg (1,102 lb) and can tow a trailer or light weapon (a mortar or anti-aircraft gun) of similar weight.

Specification
GAZ-46 MAV
Crew: 1+4
Combat weight: 2480 kg (5,467 lb)
Powerplant: one M-20 4-cylinder petrol engine developing 55 hp (41 kW)
Dimensions: length 5.06 m (16 ft 7.2 in); width 1.735 m (5 ft 8.3 in); height with hood up 2.04 m (6 ft 8.3 in)
Performance: maximum road speed 90 km/h (56 mph); maximum water speed 9 km/h (5.6 mph); range 500 km (311 miles); fording amphibious; gradient 60 per cent; trench not applicable



Still in use after more than 30 years, the GAZ-46 amphibian is being replaced in front-line service by BRDM scout cars. With a carrying capacity of 500 kg (1102 lb), it should be regarded as an amphibious field car.

USSR

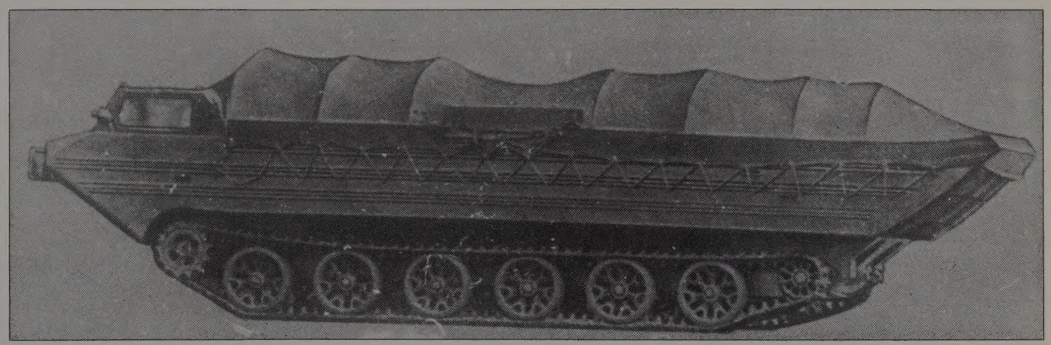
PTS amphibious vehicle

The **PTS** amphibian entered service with the Soviet army in the mid-1960s, and in comparison with the earlier K-61 amphibian has a greatly increased load-carrying capability, slightly higher speed on both land and water, and can also tow a trailer when afloat. The PTS has a steel hull with the crew compartment at the very front of the hull and the cargo area stretching back right to the rear. The crew compartment, unlike those on the earlier K-61 and BAV-485, is fully enclosed, the two-man crew entering via two circular roof hatches. An NBC system is provided to enable the vehicle to operate in an NBC-contaminated area. The engine is beneath the vehicle, with the exhaust pipes on top of the cargo compartment on each side, a configuration which in certain conditions could permit exhaust fumes to be blown back into the cargo area, an unfortunate situation when troops are being carried. The PTS can carry a maximum of 5000 kg (11,023 lb) of cargo on land and 10000 kg (22,046 lb) on water, or up to 70 or so fully equipped troops. Cargo and vehicles such as a Ural-375D 6×6 4000-kg (8,818-lb) truck can be loaded into the PTS via the rear tailgate, which has two integral loading ramps. The suspension of the vehicle is of the torsion-bar type with six dual rubber-tyred road wheels, plus a drive sprocket at the front and an idler at the rear; there are no track-return rollers. The vehicle is driven in the water by two propellers mounted in tunnels under the rear of the hull, and steered by two rudders. Before the vehicle enters the water a trim vane is erected at the front to stop water swamping the forward part of the vehicle, and the bilge pumps are switched on. All vehicles have a front-mounted winch (to recover other vehicles and equipment, or to assist in self-recovery), night driving equipment, a searchlight mounted on top of the crew compartment, radios and an intercom.

The PTS can also tow the specially developed **PKP** boat-shaped two-wheel trailer, which is provided with ramps to enable cargo to be loaded. This has two sponsons, one on each side: for land travel these are folded on top of the trailer, but before entering the water they are swung through 180° and locked in position to provide additional buoyancy. The trailer is used to carry a 122-mm (4.8-in) D-30 howitzer while the PTS vehicle carries the truck, ammunition and crew.

The latest production version is the **PTS-M**, which has minor differences including increased fuel capacity. The only known variant is one used by Poland, which has a rocket-propelled mine-clearing system mounted in the rear. In addition to being used by most members of the Warsaw Pact, the PTS is also operated by Egypt, Iraq and Syria.

The PTS has been in Egyptian service for some years, its amphibious carrying capacity having been used to good effect during the Yom Kippur war of 1973.



Water-driven by twin tunnel-mounted propellers at the rear, the large PTS is capable of carrying up to 10000 kg (22,046 lb) on water, or up to 70 men. The crew compartment at the front of the vehicle is fully sealed against NBC (Nuclear, Biological, Chemical) contaminants.

Specification
PTS
Crew: 1+1
Combat weight: on land 22700 kg (50,045 lb) and on water 27700 kg (61,068 lb)
Powerplant: one V-54P diesel developing 350 hp (261 kW)
Dimensions: length 11.50 m (37 ft 8.8 in); width 3.30 m (10 ft 10 in); height 2.65 m (8 ft 8.3 in)
Performance: maximum road speed 42 km/h (26 mph); maximum water speed 10.6 km/h (6.5 mph); range 300 km (186 miles); fording amphibious; gradient 60 per cent; vertical obstacle 0.65 m (2 ft 1.6 in); trench 2.5 m (8 ft 2.4 in)

Soviet Naval Infantry

Certainly an elite amongst the Soviet armed forces, the Naval Infantry are trained to operate far in advance of a major assault, usually by means of small-scale, disruptive amphibious operations along an enemy's coastal flank.

In the Soviet Union, as in almost every other country, the marines come under the operational control of the navy. In the West it is often thought that it is only in recent years that the Soviet marines have been established, although in fact the first 10 companies were formed by Tsar Peter the Great. After the 1917 revolution the marines virtually disappeared, although they were certainly employed in small numbers during World War II. In the 1960s the Soviet navy was given a new lease of life and in 1962 Admiral of the Soviet Fleet Gorshkov ordered the marines' reactivation.

Today the Soviet marines or, to give them their correct name, the Naval Infantry, are some 14,500 men strong and formed into five infantry brigades or regiments. The Northern, Baltic and Black Sea Fleets each have one infantry brigade, while the Pacific Fleet (based at Vladivostok) has two infantry brigades/regiments formed into one marine division. In each case the marines come under the operational control of the respective fleet commander.

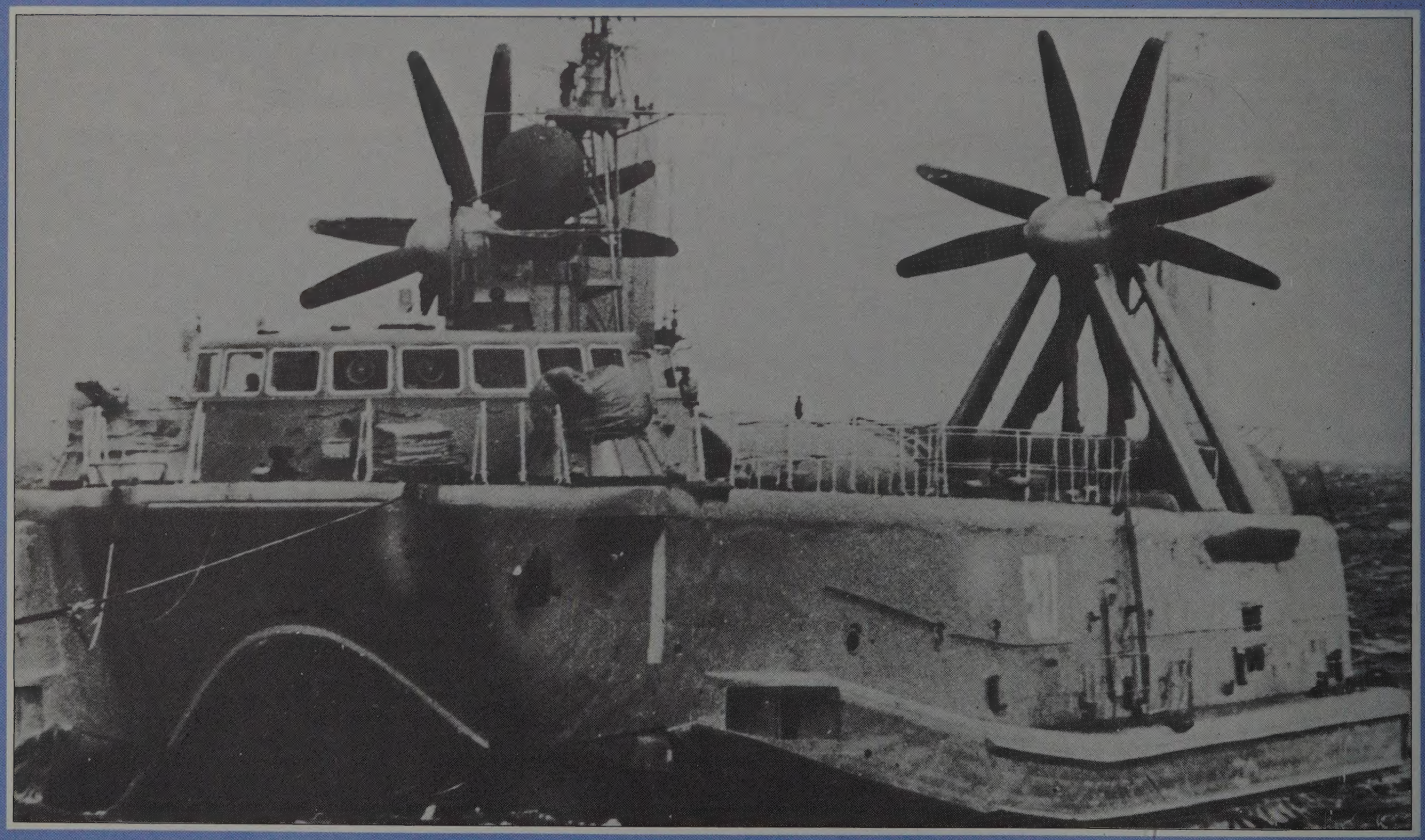
Each naval infantry brigade/regiment normally has three infantry battalions and one tank battalion plus a number of specialized companies. Each infantry battalion has a battalion headquarters, an anti-tank platoon with 100-mm (3.94-in) T-12 towed anti-tank guns and AT-3 'Sagger'/AT-5 'Spandrel' wire-guided anti-tank weapons, six 120-mm (4.72-in) towed mortars and three amphibious rifle companies. Each of the latter has a headquarters unit, three rifle platoons and a machine-gun platoon, which are carried in BTR-60P 8×8 armoured personnel carriers. In recent years the BTR-60P with its open-topped troop compartment has been replaced in many units by the BTR-60PA (fully enclosed troop comparment) and BTR-60PB (fully enclosed troop compartment and turret-mounted machine-guns).

The tank battalion has a headquarters platoon with one PT-76 light amphibious tank, and three tank companies each with one PT-76 at company headquarters and three platoons each with three tanks; this gives the tank battalion a total of 13 tanks. For operational use one company of PT-76 tanks would probably be attached to the infantry battalion. The Naval Infantry has in the past relied on naval gunfire support when ashore, but in recent years has received some 122-mm (4.8-in) 2S1 amphibious self-propelled howitzers and 122-mm (4.8-in) BM-21 multiple rocket-launchers; air defence, previously limited to 7.62-mm (0.3-in) and 12.7-mm (0.5-in) machine-guns and SA-7 man-portable SAMs, has been strengthened by ZSU-23-4 self-propelled anti-aircraft guns and SA-9 surface-to-air missile systems.

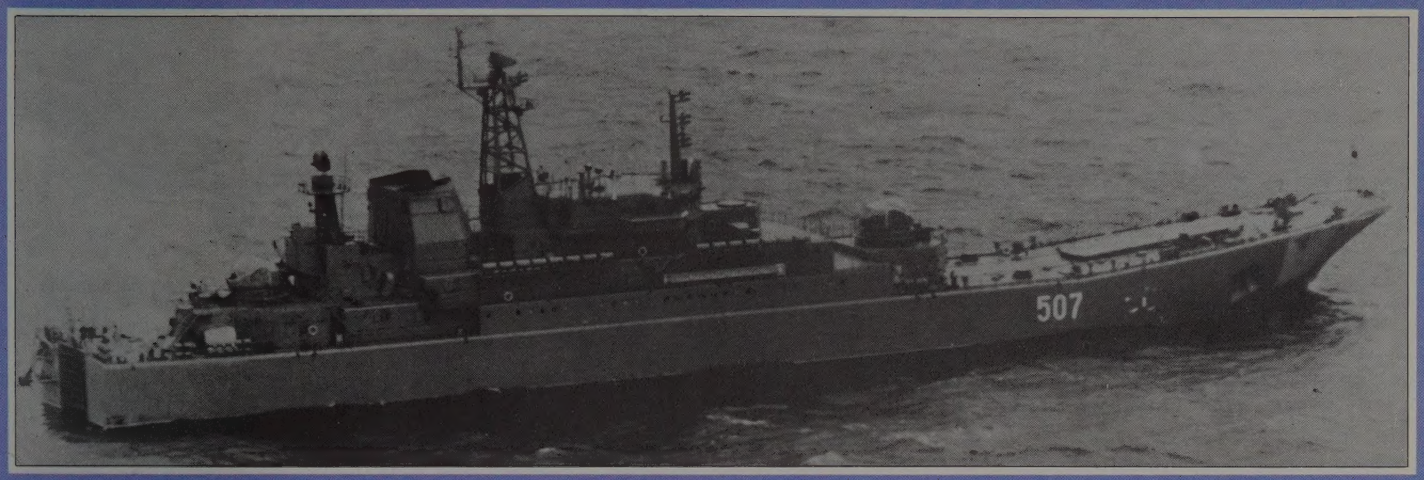
The Soviet marines do not have sufficient men or equipment to carry out sustained landings, but would in time of war be used to establish a beach-head, the army then acting as the follow up force to exploit the beach-head thus obtained. More recently it has been reported that each of the five infantry brigades has received a helicopter company, which would give greater flexibility and allow small detachments of marines to be landed inland to stop enemy reinforcements reaching the beach-head area until it had been secured.

In addition to providing the Soviet marines with new equipment, the Soviet navy has been increasing its capability to transport the marines to combat areas. Amphibious forces now available include at least two of the new 'Ivan Rogov' class of LPD, 17 of the 'Ropucha' class of LST, and 14 of the 'Alligator' class of LST. The 'Ivan Rogov' class ships can each lift a complete infantry battalion and some 20 tanks, rapid ship-to-shore transport being carried out by helicopters (the ship has one landing pad fore and aft), two 'Lebed' class air-cushion vehicles and one 'Ondatra' class LCM carried in the rear docking bay. Equipment can also be offloaded through the bow doors. Air-cushion vehicles are also used to transport Naval Infantry quickly ashore, the huge 'Aist' class craft each carrying four PT-76 light tanks and 150 troops at a speed of some 60 knots. The 'Lebed' class craft can each carry two PT-76s, or 40 tonnes of cargo or 120 troops, while the smaller 'Gus' class craft can each carry 25 troops and their equipment.

Right: Like the majority of their land counterparts, the Naval Infantry are equipped with the BTR-60 APC, which has a useful amphibious capability. Propelled by a single water jet at the rear of the hull, it can travel at up to 10 km/h (6 mph).



Below: The Soviet Union has been alone among the major powers in its large-scale use of hovercraft, despite the concept being ideally suited to amphibious operations. The 'Aist' class can carry up to 150 troops and two PT-76 light tanks.



Above: The rapid expansion of the Soviet navy has given the country's amphibious capability a much-needed boost, but as yet only small numbers of troops can be blue-water-deployed for any length of time.

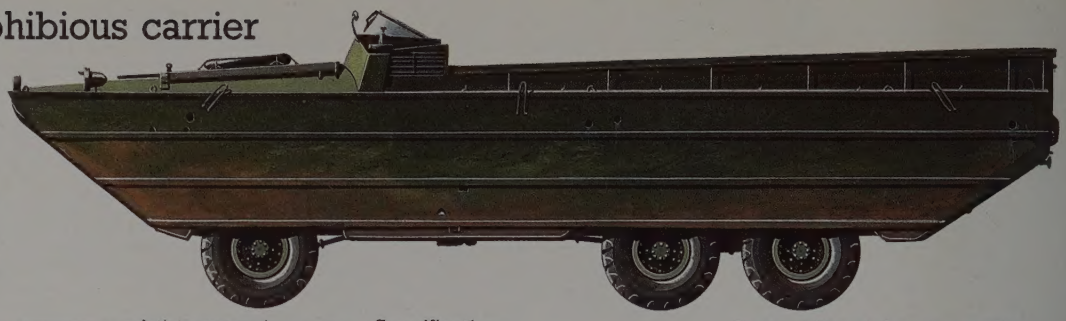
Right: Ivan Rogov *is the first assault ship with anything like the capabilities of a US Navy LPD. First seen in 1978, she can accommodate a small battalion (550 men) of infantry as well as 30 APCs and up to 10 tanks.*

Above: In their major wartime role, the Soviet marines plan to come ashore at selected points, to establish a bridgehead and to hold until regular reinforcements arrive (usually by ship). Their equipment today includes both tanks and self-propelled artillery.

Below: With fixed bayonets, a platoon leaps into action from its PTS tracked amphibian. Although small in numbers, a battalion of Soviet naval infantry is regarded by many to be amongst the most effective forces of its size in the current Soviet armed forces.

USSR

BAV-485 amphibious carrier



Following the successful use of American-supplied DUKW 6×6 amphibious vehicles by the Soviet army during World War II, it was decided to build a similar vehicle but based on a Soviet truck chassis. This finally appeared in the early 1950s as the **BAV-485**, sometimes called the **ZIL-485**. The layout of the BAV-485 is similar to that of the American DUKW with the engine and transmission at the front, crew seats to the rear of the engine compartment, and the cargo area at the rear. A maximum of 2500 kg (5,511 lb) of cargo or 25 fully equipped troops can be carried. The crew at the front are provided with a windscreen which can be folded forwards, and if required bows and a tarpaulin cover can be erected over the crew and troop compartments. A major improvement over the original American DUKW is the installation of a drop-down tailgate at the very rear of the cargo compartment, which enables light vehicles, mortars and light artillery weapons to be loaded very quickly. The engine is coupled to a manual gearbox with five forward and one reverse gear, and a two-speed transfer case. The main brakes are pneumatic, with a mechanical parking brake that operates on the rear wheels only. The BAV-485 is powered in the water by a single three-blade propeller mounted under the rear of the hull, and before the vehicle enters the water bilge pumps must be switched on.

The basic BAV-485 was based on the ZIL-151 6×6 2500-kg (5,511-lb) truck chassis built by the Likhachev Motor Vehicle Plant in Moscow between 1947 and 1958. Later production vehicles were based on the ZIL-157 6×6 2500-kg (5,511-lb) truck chassis built at the same plant between 1958 and 1961, this model being designated the **BAV-485A**. The major difference between the BAV-485 and the later BAV-485A is that the former has external air lines for the central tyre pressure-regulation system while the latter has internal air lines which are less easily damaged. The central tyre pressure-regulation system is a common feature on Soviet wheeled armoured vehicles and military trucks, and enables the driver to adjust the ground pressure to suit the ground being crossed. It is by no means a new idea, however, as the Americans had a similar system on their DUKWs during World War II. Some BAV-485s have been observed with a 12.7-mm (0.5-in) DShKM heavy machine-gun for anti-aircraft defence, this being mounted on the forward right side of the troop compartment.

Specification

BAV-485

Crew: 1+1

Combat weight: on land and on water 9650 kg (21,275 lb)

Powerplant: one ZIL-123 6-cylinder petrol engine developing 110 hp (82 kW)

Dimensions: length 9.54 m (31 ft 3.6 in); width 2.845 m (9 ft 4 in); height 2.66 m (8 ft 8.7 in)

Performance: maximum road speed 60 km/h (37.3 mph); maximum water speed 10 km/h (6.2 mph); maximum road range 480 km (298 miles); fording amphibious; gradient 60 per cent; vertical obstacle 0.4 m (1 ft 4 in); trench not applicable

Derived directly from the wartime 6×6 DUKW provided under Lend-Lease, the BAV-485 is a watertight boat-like body on a Soviet truck chassis.

Based upon ZIL trucks, the BAV-485 largely serves in second-line units of the Warsaw Pact.

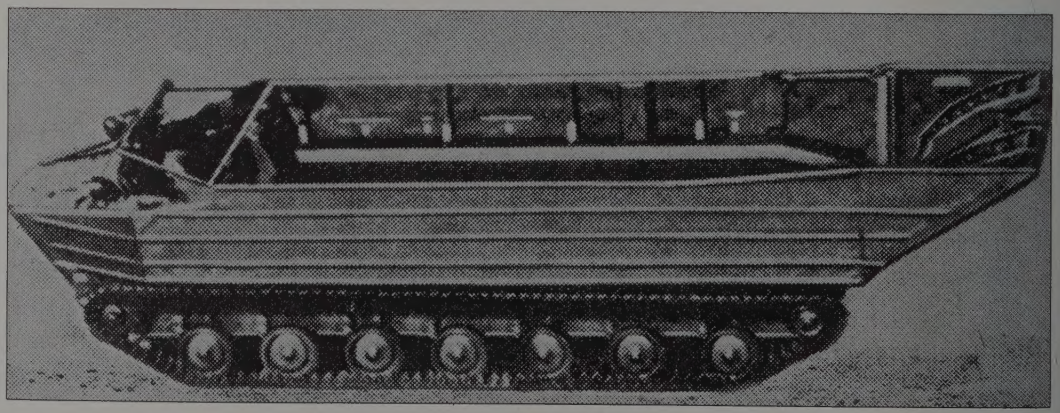
USSR

K-61 amphibious carrier

The **K-61** tracked amphibious load carrier was developed in the period immediately after World War II and can carry a maximum payload of 3000 kg (6,614 lb) on land and 5000 kg (11,023 lb) on water; in the troop transport role it can carry a maximum of 60 fully equipped troops. The K-61 was first seen in Soviet army use in the early 1950s, and was subsequently exported to most members of the Warsaw Pact as well as to Egypt and Vietnam. Egypt used the K-61 in the 1973 Middle East conflict to carry supplies across the Suez Canal. In Soviet front-line units the K-61, which is sometimes known as the **GPT**, has been replaced by the more recent PTS tracked amphibious vehicle, which has not only a greater payload capacity but also a higher road speed and increased operating range.

The K-61 tracked amphibious carrier has an all-steel hull with the engine and crew compartment at the very front. The cargo/troop area runs almost the whole length of the K-61, and to facilitate the loading of vehicles a large tailgate is provided. To protect the crew and cargo against bad weather, bows and a tarpaulin cover can be fitted over the whole of the cargo area. The suspension on each side consists of seven very small road wheels with the drive sprocket at the front and idler at the rear, and there are seven slides to support the tracks as they return. The K-61 is driven in the water by two propellers mounted under the hull rear, these being driven by a power take-off from the main engine.

In addition to carrying troops and cargo, K-61 vehicles have been used to carry a wide range of engineer equipment and weapons such as the



The view from above displays the large capacity and the loading ramps incorporated into the tailgate. Normal load can include trucks, artillery pieces or mortars.

122-mm (4.8-in) M1938 (M30) towed howitzer, 76-mm (3-in) or 85-mm (3.35-in) anti-tank guns, mortars, 14.5-mm (0.57-in) ZPU-2 twin and ZPU-4 quadruple towed anti-aircraft guns, and light vehicles such as the GAZ-63. For heavier equipments one K-61 would carry the weapon while another ferried the towing vehicle.

Specification
K-61
Crew: 1+1
Combat weight: on land 12550 kg (27,668 lb) and on water 14550 kg (32,077 lb)
Powerplant: one YaAZ-M204VKr 4-cylinder water-cooled diesel developing 135 hp (100 kW)

East Germany has the K-61 on its inventory, as have most of the Warsaw Pact nations. It has seen combat service with Egypt, in 1973, and also equips the Vietnamese army.

Dimensions: length 9.15 m (30 ft 0.2 in); width 3.15 m (10 ft 4 in); height 2.15 m (7 ft 0.6 in)
Performance: maximum land speed 36 km/h (22 mph); maximum water speed 10 km/h (6.2 mph); maximum range 260 km (162 miles); fording amphibious; gradient 40 per cent; vertical obstacle 0.65 m (2 ft 1.6 in); trench 3 m (9 ft 10 in)

USSR

GT-S tracked oversnow vehicle

The **GT-S**, sometimes called the **GAZ-47**, is believed to have been the first tracked amphibious oversnow vehicle to enter service with the Soviet army after World War II. During this conflict the Soviet army used a number of oversnow vehicles including several sled-type vehicles with a propeller at the rear. The GT-S was designed to carry a maximum payload of 1000 kg (2,205 lb) and to tow a trailer (or weapon such as a 120-mm/4.72-in mortar) weighing up to 2000 kg (4,409 lb).

The engine, more commonly the GAZ-61, is at the very front of the vehicle and coupled to a manual gearbox with four forward and one reverse gear. Some vehicles were fitted with the less powerful GAZ-47. The commander and driver are seated to the immediate rear of the engine, and behind them is the cargo area extending to the very rear of the vehicle. This cargo area is normally covered by a tarpaulin cover with small windows in the sides and rear. The tracks are 300 mm (11.81 in) wide and give a ground pressure of 0.24 kg/cm^2 (3.4 lb/sq in) loaded. The suspension is of the torsion-bar type and consists of five large rubber-tyred road wheels, the last road wheel on each side acting as the idler, and a drive sprocket at the front; there are no track-return rollers. As with the later oversnow vehicles, the GT-S is fully amphibious without preparation, being propelled in the water by its tracks.

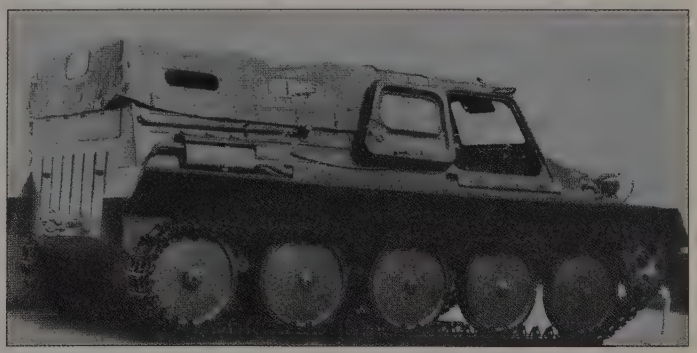
One of the more interesting versions of the GT-S was the **LFM-RVD-GPI-66**, on which the tracks are replaced by cylindrical steel pontoons powered by the main engine. This model has a much higher water speed of 20 km/h (12.4 mph), but is wholly impractical on hard surfaces such as roads.

The GT-S has been replaced in production by the **GT-SM**, which has a longer chassis with six instead of five road wheels, and is powered by a more powerful GAZ-71 V8 water-cooled petrol engine developing 115 hp (86 kW). This gives it higher road and water speeds, and the vehicle's wider tracks give a lower ground pressure and therefore better mobility across snow and swampy ground.

The GT-SM is an enlarged and more powerful version of the GT-S, with six road wheels per side instead of the five of the earlier model. It is in extensive Soviet service.

Wartime experience with fighting in the snow led to the development of the GAZ-47, or GT-S oversnow vehicle. The 1000-kg (2,205-lb) payload makes the GT-S equivalent to a light truck.

Specification
GT-S
Crew: 1+1
Combat weight: 4600 kg (10,141 lb)
Powerplant: one GAZ-61 6-cylinder water-cooled petrol engine developing 85 hp (63 kW)
Dimensions: length 4.90 m (16 ft 1 in); width 2.435 m (8 ft 0 in); height 1.96 m (6 ft 5.2 in)
Performance: maximum road speed 35 km/h (21.7 mph); maximum water speed 4 km/h (2.5 mph); maximum range 725 km (450 miles); fording amphibious; gradient 60 per cent; trench 1.3 m (4 ft 3.2 in); vertical obstacle 0.6 m (1 ft 11.6 in)



Above: Fully amphibious without prior preparation, the GT-S has been in service since 1955, and was manufactured until 1970. It is being replaced by the enlarged GT-SM.

BRAZIL

CAMANF amphibious truck

The Brazilian marines come under operational control of the Brazilian navy and have about 15,000 men organized into one amphibious division, one reinforcement command and an internal security force. Its vehicles include ENGESA EE-11 Urutu amphibious armoured personnel carriers, EE-9 Cascavel armoured cars, LARC-5 4×4 amphibious cargo-carriers and **CAMANF** amphibious trucks. On order are a small number of FMC LVTP7A1 amphibious armoured assault vehicles from the USA.

After the end of World War II Brazil was supplied with a number of American DUKW 6×6 amphibious vehicles, but by the 1970s these were becoming difficult to maintain and operate, and as with all petrol-engined vehicles there was the ever-present risk of fire. Biselli Viaturas e Equipamentos Industriais of Sao Paulo had for some time been supplying the Brazilian armed forces with equipment, including tank transporters, and in the mid-1975s started design work on the CAMANF (Caminhao Anfibio, or amphibious truck) and in the late 1970s the first batch of 15 vehicles was delivered to the Brazilian marines. The vehicle is essentially a 6×6 version of a Ford F-7000 chassis fitted with a watertight body. Some sources have indicated that it is almost identical to the original American body with modifications to suit the requirements of the Brazilian marines, including a much stronger bow to enable the vehicle to operate in rougher water and to push beached landing craft back into the water.

In appearance the CAMANF is almost identical to the American DUKW designed in the early days of World War II, with the engine compartment at the front and the crew and troop compartment towards the rear. The cargo area is provided with removable bows and a tarpaulin cover, and a ring-mounted 12.7-mm (0.5-in) M2 HB anti-aircraft machine-gun can be fitted over the right side of the crew compartment. The vehicle can carry a load of 5000 kg (11,023 lb) on land and very calm water, but in rougher water it is limited to 2500 kg (5,511 lb). Before entering the water a trim vane is erected at the front of the vehicle and the bilge pumps are switched on. The CAMANF is propelled in the water by a single propeller mounted under the rear of the hull. All six wheels are fitted with a tyre pressure-regulation system that allows the commander to adjust the tyre pressure to suit the type of ground being crossed. Tyres are all 9.00×20, and a spare wheel and tyre are carried on the rear of the vehicle.

Having used the DUKW for many years, the Brazilian replacement is virtually identical, but with minor modifications to suit Brazilian maritime requirements. Maximum water speed is 14 km/h (8.7 mph).

The 5000-kg (11,023-lb) payload of the CAMANF is considerably reduced in rough water, but the bow has been strengthened so that handling in such conditions is improved.

Specification
CAMANF
Crew: 1+2
Combat weight: 13500 kg (29,762 lb)
Powerplant: one Detroit-Diesel Model 40-54N diesel engine
Dimensions: length 9.50 m (31 ft 2 in); width 2.50 m (8 ft 2.4 in); height 2.65 m (8 ft 8.3 in)
Performance: maximum road speed 72 km/h (45 mph); maximum water speed 14 km/h (8.7 mph); maximum road range 430 km (267 miles); fording amphibious; gradient 60 per cent; trench not applicable; vertical obstacle 0.4 m (1 ft 3.7 in)

SPAIN

Pegaso VAP 3550/1 amphibious vehicle

In Spain, as in most countries the marines come under the operational control of the navy. Today the Spanish marines consist of a force of about 12,000 men organized into five garrison regiments and one regiment that comprises two infantry, one support and one logistics battalion. Equipment includes M48 tanks, LVTP7 amphibious assault vehicles, 106-mm (4.17-in) recoilless rifles, 105-mm (4.13-in) OTO Melara pack howitzers, 105-mm (4.13-in) M52 self-propelled howitzers and **Pegaso VAP 3550/1** amphibious vehicles. The last was designed by ENASA to meet the requirements of the Spanish navy for an amphibious wheeled vehicle that could be launched from a Landing Ship Tank (LST) while carrying a payload of 3000 kg (6,614 lb), reach the coast under its own power and then travel inland to a point where the cargo would be unloaded with the assistance of an onboard crane.

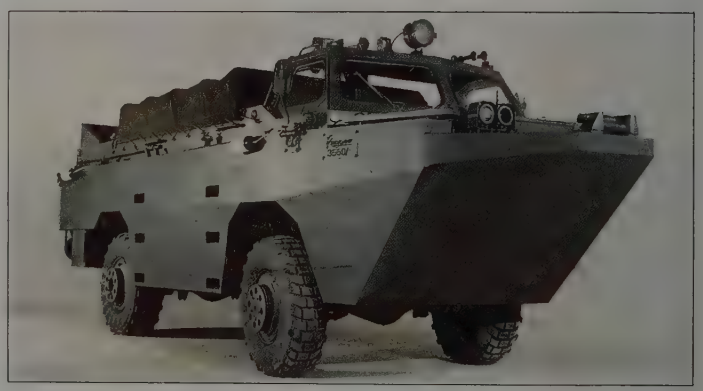
The VAP 3550/1 uses many of the automotive components from the Pegaso 3045 4×4 and Pegaso 3050 6×6 series of trucks which have been produced in large numbers for the Spanish army, navy, air force and marines over the last 15 years. This makes for easier training and reduced maintenance.

The hull of the VAP 3550/1 is of all-welded steel construction with a maximum thickness of 6 mm (0.24 in), and is divided into a number of watertight compartments; if any one of these is punctured the vehicle will not sink. The crew compartment is towards the front of the vehicle, with the driver seated on the left and the other two crew members to his right; the top, front and sides of the crew compartment are covered, but the back is open. The cargo compartment is in the centre and is normally fitted with removable bows and a tarpaulin cover; there is no provision for loading wheeled vehicles, the normal role of the vehicle being the carriage of bulk cargo. To the rear of the cab is a hydraulic crane with an extending jib which can lift a maximum load of 350 kg (772 lb).

The engine compartment is at the rear with the air inlet/air outlet louvres and exhaust pipe mounted above it. The engine is coupled to a manual gearbox with six forward and one reverse gear and a two-speed transfer case. Steering is power-assisted on the front wheels.

Unlike many amphibians, which are impelled on the water by propellers, the VAP 3550/1 is powered by two waterjets, one mounted on each side of the hull rear, and these give excellent waterborne manoeuvrability. The vehicle is also fitted with two automatic bilge pumps with a maximum capacity of 3600 litres (792 Imp gal) per hour and two pumps with a maximum capacity of 6000 litres (1,320 Imp gal) per hour, while at the very front is a winch with a capacity of 4500 kg (9,921 lb) for self-recovery operations.

In addition to serving with the Spanish navy and marines, the type has been exported: seven were delivered to Mexico in 1982, and a quantity is reported to have been supplied to Egypt. The Italian company Astra has a licence to build this vehicle.



Designed to operate from Spanish navy LSTs (Landing Ships Tank), the Pegaso VAP 3550/1 is powered in water by two waterjets driving the vehicle at some 55 kts when afloat. Standard payload is 3000 kg (6,614 lb).

Specification
Pegaso VAP 3550/1
Crew: 1+2
Combat weight: 12500 kg (27,558 lb)
Powerplant: one Pegaso 9125/5 diesel developing 190 hp (142 kW)
Dimensions: length 9.058 m (29 ft 8.6 in); width 2.50 m (8 ft 2.4 in); height to top of cab 2.50 m (8 ft 2.4 in)
Performance: maximum road speed 87 km/h (54 mph); maximum water speed 10 km/h (6.2 mph); range on land 800 km (497 miles); range on water 80 km (49.7 miles); fording amphibious; gradient 60 per cent; trench not applicable

USA

LVTP7 armoured amphibious assault vehicle

Storming ashore from their LVTP7 amphibians, these US Marines form part of the largest amphibious force in the world. Their armoured vehicle is an important component in US power projection capabilities.

After the evaluation of a number of proposals for a new armoured amphibious assault vehicle to replace the LVTP5 family, the FMC Corporation was awarded a development contract by the Naval Ship Systems Command and the first of 15 **LVTPX12** prototypes were completed in 1967. Following trials, the vehicle was standardized as the **LVTP7 (Landing Vehicle Tracked Personnel Model 7)**, and in 1970 FMC was awarded a contract for 942 vehicles at total value of $78.5 million. The first vehicles were completed in 1971 and production continued until 1974. In addition to the US Marine Corps, sales of the LVTP7 and its variants were also made to Argentina (21), Italy (25), South Korea (61), Spain (19), Thailand (23) and Venezuela (11). The type's only combat use, apart from peacekeeping duties in Lebanon, has been with the Argentine marines during the 1982 invasion of the Falklands, when one vehicle was knocked out by the Royal Marines with a Carl Gustav light anti-tank weapon.

More recently the LVTP7A1 has entered production for the US Marines, and most of the original LVTP7 vehicles are to be brought up to this improved standard, which includes replacement of the original Detroit-Diesel engine by a Cummins diesel, and incorporation of passive night-vision devices, a smoke-generating capability, a fire-suppression system, improved ventilation for the troop compartment, a Position Location and Reporting System and improvements to the 12.7-mm (0.5-in) weapon station. For trials purposes three LVTP7 vehicles have recently been fitted with a one-man turret armed with a 40-mm grenade-launcher and a 12.7-mm (0.5-in) machine-gun, but no production orders have yet been placed.

The LVTP7 has a hull of all-welded aluminium construction with the driver at the front on the right and the vehicle commander to his rear. The engine and transmission are at the front, with the one-man turret (armed with a 12.7-mm/0.5-in machine-gun) on the right; 1,000 rounds of ammunition are carried for this weapon. The troop compartment is at the rear of the vehicle, and the normal means of entry and exit to this is a large power-operated ramp in the hull rear. Over the top of the troop compartment is a three-part roof hatch that opens sideways to enable cargo and troops to be loaded when the vehicle is alongside ships. The 25 marines are seated on three bench seats, one down each side of the hull and one in the centre; the last can be folded to enable up to 4536 kg (10,000 lb) of cargo to be carried.

Suspension of the LVTP7 is of the torsion-bar type, and consists of six dual rubber-tyred road wheels, with a drive sprocket at the front and idler at the rear; there are no track-return rollers. When afloat the vehicle is normally propelled by two waterjets at the hull rear, one on each side, but if these fail the LVTP7 can also be propelled by its tracks at the slower speed of 7.2 km/h (4.5 mph).

On the basic hull of the LVTP7 several specialized versions of the vehicle have been developed. The command model, the **LVTC7**, has extensive communications equipment and a 12-man crew. The recovery member of the family is the **LVTR7**, which is fitted with a winch for recovery of vehicles, a crane for changing components in the field, and a complete set of tools and other specialized equipment. There was to have been an engineer vehicle with hydraulically-operated dozer blade (at the front of the hull) and a mine-clearing system, but this was not placed in production although a prototype was built. There was also to have been a 105-mm (4.13-in) howitzer model to replace the LVTH6, but this did not reach even the prototype stage. Undergoing trials in 1984 was an LVTP7 with the turret of the Sheridan light tank armed with a 105-mm (4.13-in) gun. The chassis of the LVTP7 was also used as the basics for the **Mobile Test Rig** which was armed with a laser to shoot down aircraft. This was successfully tested in the mid-1970s but did not enter service.

Specification

LVTP7

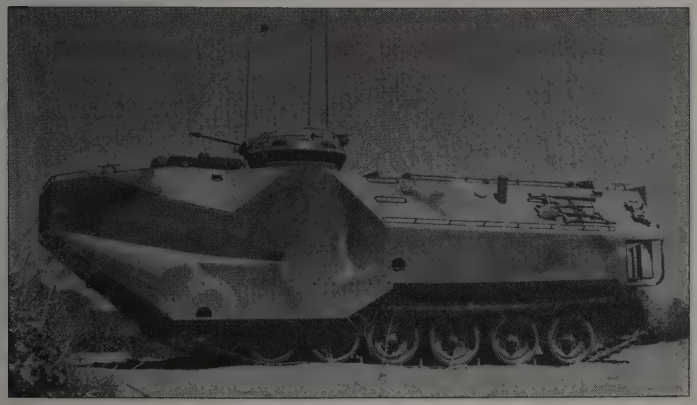
Crew: 3+25

Combat weight: 22837 kg (50,348 lb)

Powerplant: one Detroit-Diesel Model 8V-53T developing 400 hp (298 kW)

Dimensions: length 7.943 m (26 ft 0.7 in); width 3.27 m (10 ft 8.7 in); height overall 3.263 m (10 ft 8.5 in)

Performance: maximum road speed 64 km/h (40 mph); maximum water speed 13.5 km/h (8.5 mph); maximum road range 482 km (300 miles); fording amphibious; gradient 60 per cent; trench 2.438 m (8 ft 0 in); vertical obstacle 0.914 m (3 ft 0 in)

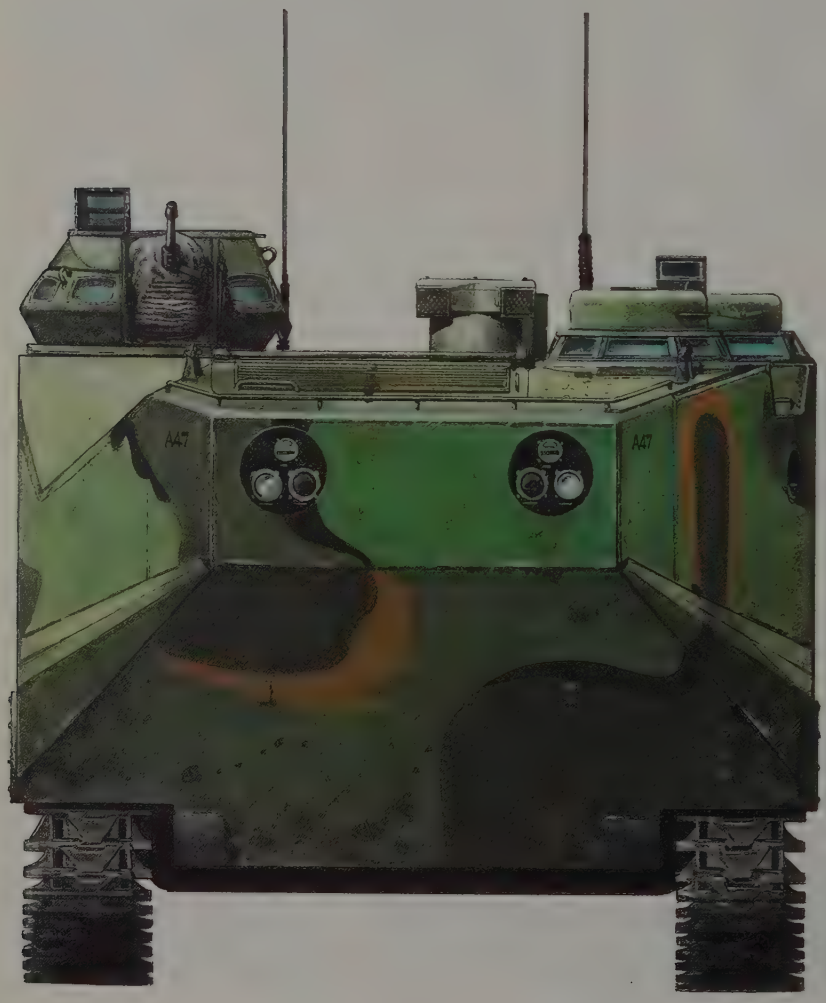


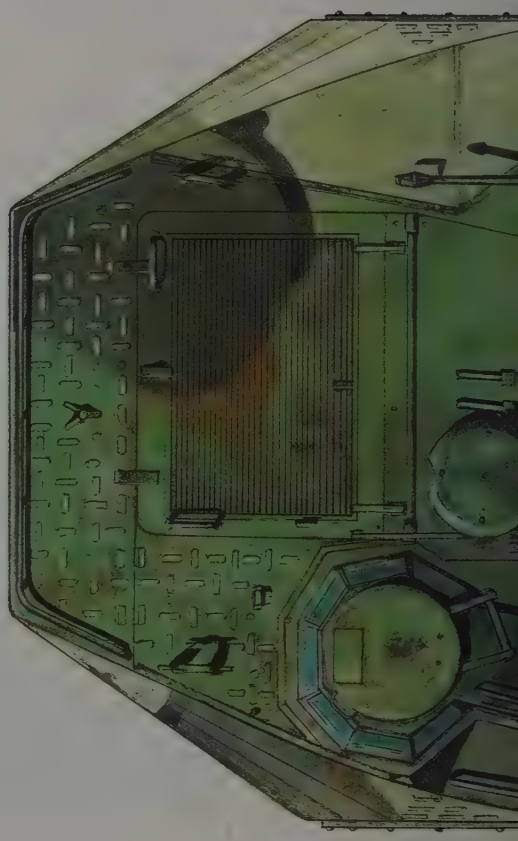
Left: The LVT7 series are not small vehicles, being 7.94 m (26 ft 1 in) in length, and weighing in at 22838 kg (50,348 lb). Only the superpowers can afford to develop such armoured vehicles specifically for their amphibious forces.

Above: With a seven-hour waterborne endurance, the LVTP7 can be launched up to 50 km (31 miles) from the beach, and carry up to 25 fully-armed troops or over 4500 kg (9,900 lb) of cargo in the basic version.

LVTP7 armoured amphibious assault vehicle

The LVTP7 has an all-welded aluminium hull with a maximum armour thickness of 45 mm on the hull sides, sufficient to protect the occupants from shrapnel or small arms fire. Twenty-five fully-equipped Marines can be carried, seated on three bench seats. They exit the vehicle through the power-operated ramp at the hull rear, which has a door in the left side in case of power failure. A Marine Corps Assault Amphibian battalion is equipped with 187 LVTP7s plus five LVTR7 recovery vehicles and 12 LVTC7 command models.





PETER SARSON / TONY BRYAN

US Amphibious Development

The nature of the Pacific conflict led to a US involvement with amphibious war which has lasted to this day. This involvement has led to a continual requirement for special vehicles.

The development of the full-tracked amphibious vehicles used so successfully by the US Marine Corps can be traced back to the early 1930s, when Donald Roebling developed a vehicle capable of carrying out rescue missions in the Florida Everglades. The first prototype was completed in 1935, and though possessing a land speed of 40 km/h (25 mph) was very slow in the water. Over the next four years further development was carried out and the water speed increased to 14.5 km/h (9 mph). The US Marine Corps subsequently ordered three improved vehicles, and quickly followed with a production order for 200 more. The latter was officially called the LVT1 (Landing Vehicle Tracked Model 1), but was more commonly known as the Alligator or Amtrack. The first models were unarmoured and used for carrying supplies, but armoured models were soon developed and the vehicles were used for amphibious assault operations. Later in the war, fire-support models were developed, the first with a turret-mounted 37-mm (1.46-in) gun but later models with the complete turret of the M8 howitzer motor carriage armed with a short-barrel 75-mm (2.95-in) howitzer. By the end of World War II no less than 18,620 LVTs had been built by four manufacturers at seven locations. In addition to being used by the US forces, LVTs were also supplied to the Free French, Nationalist Chinese and British. In the post-war period the French army used LVTs in Indo-China, while France and the UK used them during the 1956 invasion of Suez. The vehicles were also supplied post-war to Italy, the Netherlands, South Korea and Thailand; indeed, some reports state that they are still in service with the Philippines and Taiwan in 1984.

After the end of World War II some of the older LVTs were scrapped, but many others were rebuilt to continue in service until the arrival of the LVTP5 in the early 1950s. The LVT3 was fitted with a small machine-gun turret over its forward hull and provided with full overhead protection for the rear troop compartment to become known as the LVT3C. The LVA(A)5 used in the fire-support role with its 75-mm (2.95-in) howitzer was also modernized, and both of these types were used during the Inchon landings in Korea in September 1950.

The original LVTs suffered from a number of drawbacks apart from their poor armour protection: they were unreliable and prone to mechanical failure, the troop compartment had no overhead protection from shell bursts, and the troops had to leave the vehicle by climbing over the sides. Late production vehicles were fitted with a power-operated ramp at the hull rear which enabled troops and supplies to be unloaded quickly, and the type could also carry a Jeep or 57-mm (2.24-in) anti-tank gun.

Late in 1950 the Ingersoll Products Division of the Borg Warner Corporation was awarded a contract by the Bureau of Ships for the design, development and construction of prototypes of a new family of landing vehicle tracked. Design work started in January 1951, and by August 1951 the first prototype had been completed under the designation LVTPX1. The company was no stranger to LVTs, as during World War II it had been involved in the production of the LVT1, LVT2, LVT3 and LVT4. Production began under the designation LVTP5 (Landing Vehicle Tracked Personnel Model 5) in 1952 and continued until 1957, by which time 1,124 had been built by five companies. Baldwin-Lima-Hamilton built 91, FMC Corporation 313, Ingersoll 239, St Louis Car Manufacturing Company 425, and Pacific Car and Foundry 56.

Korea, 15 September 1950, and the first waves of the 1st Marine Division head into Inchon harbour aboard their World War II-vintage AMTRACs (Amphibious Tracked Vehicles).

The arrival of the LVTP5

The layout of the LVTP5 was very different from the original LVTs as the troop compartment was at the very front and the engine compartment at the very rear. The troops entered the vehicle via the hydraulically-operated ramp at the front, and a total of 34 fully equipped US Marines could be carried seated on bench seats, though in an emergency 45 could be carried standing up. With its seats folded up the LVTP5 could carry 5443 kg (12,000 lb) of cargo afloat or 8165 kg (18,000 lb) of cargo on land. Light vehicles and weapons could also be carried in the troop compartment, for example the 105-mm (4.13-in) M101 towed howitzer, its crew and 90 rounds of ammunition. When alongside a ship, cargo and men could be loaded via the large cargo hatches in the roof. The LVTP5 was powered by a Continental LV-1790-1 V12 water-cooled petrol engine developing 810 hp (604 kW) and coupled to a CD-850 series transmission. The vehicle had a maximum road speed of 48.28 km/h (30 mph) and a water speed of 19.3 km/h (12 mph), but because of its weight and high fuel consumption its range of operation on land was only 359 km (223 miles). When afloat the LVTP5 was propelled by its tracks, each of which had no less than 135 blocks, each of them with an inverted water grouser. As the LVTP5 had been rushed into service during the Korean War many problems soon became apparent, and the vehicle proved very difficult to maintain. Many LVTPs were subsequently improved, being redesignated LVTP5A1. The basic vehicle had a three-man crew consisting of commander, driver and machine-gunner, the last in the turret over the forward part of the troop compartment and armed with a single 7.62-mm (0.3-in) machine-gun, for which 2,000 rounds of ammunition were carried.

The LVTP5 was the basic member of a complete family of vehicles. The LVTH6 (Landing Vehicle Tracked Howitzer Model 6) was fitted over the troop compartment with a turret housing a short-barrel 105-mm (4.13-in) howitzer, a 7.62-mm (0.3-in) co-axial machine-gun and an external roof-mounted 12.7-mm (0.5-in) anti-aircraft machine-gun. When afloat, a total of 100 rounds of 105-mm, 1,000 rounds of 7.62-mm and 1,050 rounds of 12.7-mm ammunition were carried.

The command member of the family, the LVTC5 (Landing Vehicle Tracked Command Model 5), carried 12 men (a three-man crew plus nine command staff) and was fitted with extensive communications equipment. The recovery vehicle was the LVTR1 (Landing Vehicle Tracked Recovery Model 1) and was not fitted with a machine-gun turret; standard equipment included welding gear, an air compressor a generator, a lifting boom and a winch.

The LVTE1 (Landing Vehicle Tracked Engineer Model 1) was used to clear obstacles off the beach and was fitted with a special hydraulically-operated dozer blade on the front of the hull, together with a rocket-propelled mine-clearing system.

The LVTP5 series was used by the US Marine Corps in South Vietnam, but from 1971 was gradually replaced by the LVTP7 series, designed and built by the FMC Corporation. It was thought that all of the LVTP5s had been scrapped or expended as range targets, but it is now known that some were passed onto Chile, the Philippines and Taiwan and that these remain in service in 1984.

In addition to the previously mentioned production members of the LVTP5 family there were many trials vehicles. These included the LVTAAX1 anti-aircraft vehicle, which has the complete turret of the M42 Duster self-propelled anti-aircraft gun over the troop compartment; this turret is armed with twin 40-mm guns.

The LVT5 family was used for a variety of purposes, one member being the LVTH6 howitzer. The bulk of the vehicle is apparent from the relatively small appearance of the tank-sized 105-mm gun turret.

In the early 1950s the Ordnance Division of FMC Corporation, which had produced 11,251 LVTs during World War II, built four prototypes of a full-tracked armoured amphibious troop carrier called the LVTPX2. This vehicle incorporated many automotive and suspension components of the M59 full-tracked armoured personnel carrier that the company was building for the US Army. The four prototypes were delivered to Camp Pendleton in February 1953, and each vehicle was put through 350 hours of endurance testing over all types of terrain and through heavy surf. These vehicles were then modified and further trials were carred out in 1954, 1955 and 1956, after which the type was declared standard and given the type designation LVTP6. In the end, however, the LVTP6 never entered production. The LVTHX4 was the fire-support vehicle and fitted with a turret armed with a 105-mm (4.13-in) howitzer. The LVTAAX2 was fitted with the twin 40-mm turret of the M42 self-propelled anti-aircraft gun (also fitted to the previously-described LVTAAX1 vehicle). A bolt-down 107-mm (4.2-in) mortar kit was also developed for the LVTP6, and projected versions included recovery, engineer and command vehicles.

While the LVTP5 was a major improvement over the original LVTs, it proved difficult to maintain and according to the US Marine Corps needed 22 hours of maintenance for every 100 hours of operation; it also had no less than 152 grease points.

The LVTP5 family has now been replaced by the LVTP7/LVTP7A1 series, which is fully described separately. This needs only six hours of maintenance for every 100 hours of operation, has only 29 grease points, a greater range of operation on land and water, and higher road and water speeds, the latter achieved by the use of two hull-mounted waterjets.

The LVTP7 series was to have been replaced by the Landing Vehicle Assault (LVA), and in 1976 the US Navy awarded conceptual design contracts to the Bell Aerospace Division of Textron Inc., to the FMC Corporation and to the Pacific Car and Foundry Company. The following year Curtiss-Wright was awarded a separate contract for the development of a stratified-charge rotary engine for the LVA. The original US Marine Corps requirement was for a vehicle with a water speed of between 40 and 64 km/h (25 and 40 mph), a land speed of between 64 and 88 km/h (40 and 55 mph), good operating range on both land and water, the ability to carry between 18 and 22 fully equipped troops, and the provision of a turret-mounted 25-mm cannon plus co-axial 7.62-mm (0.3-in) machine-gun. The idea was that two of the companies would be awarded further contracts which would eventually lead to the construction of full-scale mockups. But in 1979 the Landing Vehicle Assault was cancelled and contracts were subsequently awarded for the Landing Vehicle Tracked (Experimental), or LVT(X), to General Dynamics Land Systems Division, FMC and Bell Aerospace. As of late 1984 all three companies had submitted their proposals and two companies will probably be awarded contracts to build prototype vehicles, one of which will eventually be placed in production. All companies have proposed vehicles fitted with a two-man power-operated turret armed with at least a 25-mm cannon plus a co-axial 7.62-mm (0.3-in) machine-gun. The Bell and General Dynamics proposals also have two remote-controlled 7.62-mm (0.3-in) machine-gun installations above the rear troop compartment; these have been fitted as the US Marine Corps expects that in future amphibious operations the US Marines will have to fight further inland than in the past. Although the LVT(X) will have improved mobility, firepower and armour protection over the current LVTP7 series, it will not have a dramatic increase in water speed: unless there is a considerable breakthrough in hull design (apart from the installation of hovercraft type skirts as proposed for the now defunct Landing Vehicle Assault) there is little scope for further development.

The LVT7 family, while smaller than the gargantuan LVT5 series, is much more effective, and considerably less expensive to service and run. It also has greater range on land and in water.

USA

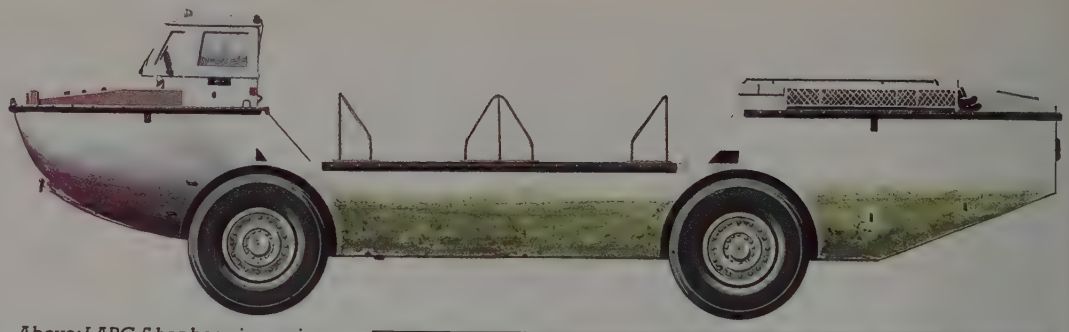
LARC-5 amphibious cargo carrier

In the 1950s the US Transportation Engineering Command issued a requirement for a vehicle capable of transporting 4356 kg (10,000 lb) of cargo from ships lying offshore, across the beach and then to inland dumps. Development of this vehicle, subsequently called the **Lighter Amphibious Resupply Cargo 5-ton (LARC-5)** was carried out by the Borg Warner Corporation. Production was initially undertaken by the Adams Division of Le Tourneau Westinghouse, but final production came from Condiesel Mobile Equipment Division, and between 1962 and 1968 about 950 vehicles were built. In addition to being used by the US Army, the LARC-5 is also known to be in service with Australia, West Germany and Argentina. The last used the vehicle during its invasion of the Falklands in 1982, but by the time of the islands' recapture by the British all of the vehicles had been returned to the mainland.

The hull of the LARC-5 is of all-welded aluminium construction with the cab at the front of the vehicle, cargo areas in the centre and the engine compartment at the very rear. The cab, which is open at the rear, has seats for the driver and two passengers and is provided with a magnetic compass, a heater and windscreen defroster, a portable fire extinguisher, a radio, and a portable lamp and cable. If required, the rear of the cab can be shielded by a fabric cover.

The cargo area is open on the top, but fabric curtains reinforced with stranded wire rope can be installed on each side to protect the cargo from spray. In place of cargo up to 20 fully equipped troops can be carried by the LARC-5, and some vehicles have been fitted to the rear of the cab with a hydraulically-operated boom that can lift a maximum load of 2495 kg (5,500 lb).

The engine compartment is fully enclosed and provided with a fire extinguisher operated from the cargo-deck rear bulkhead. The first production vehicles were powered by a petrol engine but final examples have a diesel engine which reduces the danger of fire.



Above: LARC-5 has been in service since 1962, providing transportation for up to 20 fully equipped troops or 4356 kg (10,000 lb) of cargo.

On roads 4×2 drive is normally used, the 4×4 drive being engaged only when the vehicle is being driven across country; a two-speed transfer case is fitted (high and low ranges). The LARC-5 is powered in the water by a three-blade propeller mounted under the hull at the rear. Both power-operated and manual bilge pumps are fitted for the disposal of any water that seeps into the vehicle. The LARC-5 has no suspension as such, the 18.00×25 tyres absorbing all of the shock. Steering is power-assisted on the front wheels only.

Specification

LARC-5
Crew: 1+2
Combat weight: 14038 kg (30,948 lb)
Powerplant: one Cummins V8 diesel developing 300 hp (224 kW)
Dimensions: length 10.668 m (35 ft 0 in); width 3.149 m (10 ft 4 in); height overall 3.034 m (9 ft 11.4 in)
Performance: maximum road speed 48.2 km/h (30 mph); maximum water speed 16 km/h (10 mph); maximum road range, empty 402 km (250 miles); fording amphibious; gradient 60 per cent; trench not applicable; vertical obstacle about 0.5 m (1 ft 7.7 in)

An LARC-5 of the Australian Army negotiates rough surf, giving a good impression of the conditions that any modern amphibious supply vehicle has to cope with in order to be effective.

USA

LARC-15 amphibious cargo carrier

The **Lighter Amphibious Resupply Cargo 15-ton (LARC-15)** is a member of a family of 4×4 vehicles designed to meet the requirement of the US Army to transport cargo from ships, over the beach and on to points inland. The other vehicles are the smaller LARC-5 and the much larger LARC-60. The LARC-15 was designed by the Ingersoll-Kalamazoo Division of the Borg Warner Corporation, production being undertaken by the Military Products Division of the Fruehauf Corporation. The first production vehicles were completed in the mid-1960s. The only known operators of the LARC-15 are the USA and West Germany.

The LARC-15 has been designed to carry a maximum load of 15 US tons (13608 kg/30,000 lb) and operate in surf up to 3.048 m (10 ft) high. A major difference between the LARC-5 and the LARC-15 is that the latter has the engine compartment and cab at the rear to make possible the incorporation of a hydraulically-operated bow ramp for the onloading of tracked and wheeled vehicles. Typical loads can include a 155-mm (6.1-in) M114 towed howitzer, whose crew, ammunition and 2½-ton 6×6 towing vehicle are carried in another LARC-15. The sides of the freight area can be fitted with fabric curtains reinforced with stranded wire rope to stop spray reaching the cargo, and with these curtains removed cargo can be loaded and unloaded from the side with the aid of a fork-lift truck.

The engines are mounted under the fully enclosed cab, which can be removed as a complete unit. The engines are coupled to a transmission and a two-speed transfer case (high and low), and in the water the vehicle is propelled by a four-blade propeller mounted under the rear of the hull; waterborne steering is via the wheels and a rudder. The vehicle has no suspension system, the large 24.00×29 tyres absorbing the shock. Steering is power-assisted and the driver can select one of three different modes; two-wheel, four-wheel and oblique

The LARC-15 is the larger brother of the LARC-5, with a capacity of 15 US tons (13608 kg/30,000 lb). Large trucks can thus be carried, but on-land performance is limited when carrying large loads.

(also known as crab), the last being used in very difficult conditions such as those likely to be found on many beaches.

The **LARC-60** was the first of the LARCs to be developed (in the early 1950s) by the Pacific Car and Foundry Company of Renton, Washington. Its normal maximum load of 60000 kg (132,276 lb) can be increased to 100000 kg (220,460 lb) in an emergency, and like other LARCs it was widely used in South Vietnam to transport cargo from ships onto the beach, where it was unloaded into trucks for transportation to supply dumps inland. An unusual feature of the LARC-60 is that it is powered by four engines, one powering each of the four road wheels. When afloat, the vehicle is powered by two propellers at the rear, each of these being driven by two engines. The large 36.00×41 tyres are fitted with a central tyre pressure-regulation system, a feature very useful for crossing deep sand as the pressure can be decreased for improved traction.

Specification
LARC-15
Crew: 1+1
Combat weight: 34100 kg (75,177 lb)
Powerplant: two Cummins V8 diesels each developing 300 hp (224 kW)
Dimensions: length 13.716 m (45 ft 0 in); width 4.419 m (14 ft 6 in); height with cab 4.724 m (15 ft 6 in)
Performance: maximum road speed 50 km/h (31 mph); maximum water speed 15 km/h (9.3 mph); maximum road range, empty 482 km (300 miles); fording amphibious; gradient 40 per cent; trench not applicable; vertical obstacle not known

An early LARC-15 is seen with ramp lowered and an M-56 self-propelled anti-tank gun prepared to unload.

The bulk of the vehicle enables it to operate through up to 3.05 m (10 ft) of surf

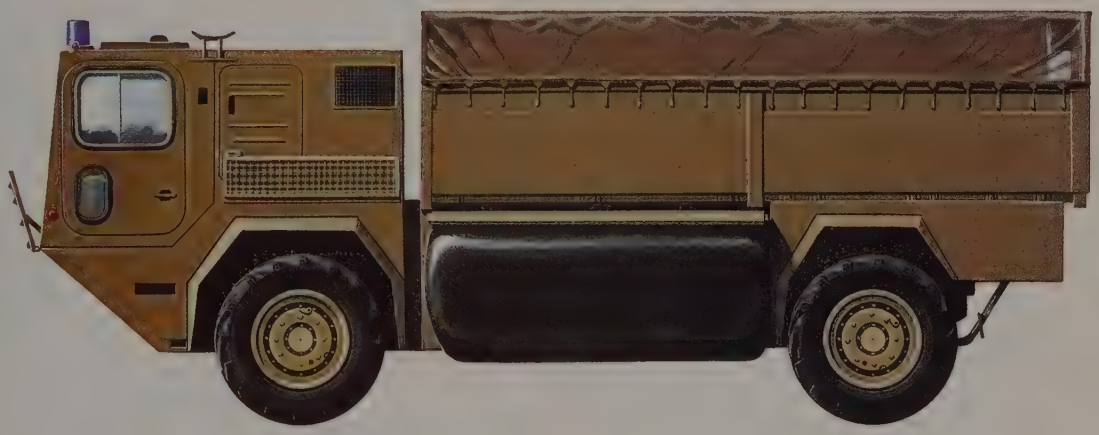
WEST GERMANY

EKW Bison amphibious truck

The **EKW Bison** 4×4 amphibious truck has been developed as a private venture by the Eisenwerke Kaiserlautern Goppner company of West Germany for both civil and military applications, and was seen in public for the first time in 1982. EWK has considerable experience in the development of amphibious vehicles, having already designed the **ALF-2** amphibious fire tender, the **M2** amphibious bridge/ferry systems used by the British, West German and Singapore armies, and more recently the **APE** 4×4 amphibious armoured reconnaissance vehicle. The last was developed to meet the requirements of the West German army but has yet to enter production because of a shortage of funds.

The Bison has a fully enclosed forward control cab with the engine to its rear. The engine is coupled to a fully automatic transmission with six forward and one reverse gear. The load area is at the rear and provided with drop sides, bows and a tarpaulin cover. The normal load is 5000 kg (11,023 lb), but in an emergency a total of 7000 kg (15,432 lb) of cargo can be carried. Before the vehicle enters the water a trim vane is erected at the front, and the flotation bags are extended to each side and inflated with the aid of an APU-driven pump; the flotation bags give additional buoyancy when the Bison is afloat. The APU also provides the power for the two propellers which are mounted at the rear of the hull. These propellers have been designed by Schottel and can be traversed through 360° for increased waterborne manoeuvrability. (Schottel propellers are fitted to many of the armoured fighting vehicles used by the West German army, including the 6×6 Transportpanzer and the 8×8 Luchs reconnaissance vehicle.) Steering is power-assisted to reduce driver fatigue, and dual brakes are fitted as standard (hydraulic on the front wheels and pneumatic on the rear). The Bison is also fitted with a central tyre pressure-regulation system that allows the driver to adjust the tyre pressure to suit the type of terrain being crossed. The Soviets have fitted such a system to most of their wheeled armoured vehicles and many of their cross-country trucks since shortly after the end of World War II.

Another West German designer of amphibious vehicles is Hans Trippel, who has been working on such vehicles for some 50 years and has recently designed the Trippel 4×4 550-kg (1,212-lb) light vehicle which is propelled in the water by two propellers (mounted at the hull rear), each of which can be traversed through 360°. A bilge pump is fitted as standard and this is automatically activated when the vehicle enters the water, so there is no possibility of the driver forgetting to switch it on. This vehicle has yet to enter production for military use.



The EKW Bison was originally designed for civil use in underdeveloped regions, but the obvious military applications of such a vehicle were soon to lead to forces interest.

Specification
Bison
Crew: 1+1
Combat weight: 16000 kg (35,274 lb)
Powerplant: one KHD V8 air-cooled diesel developing 320 hp (239 kW)
Dimensions: length 9.34 m (30 ft 7.7 in); width 2.5 m (8 ft 2.4 in); height to cab roof 2.96 m (9 ft 8.5 in)
Performance: maximum road speed 80 km/h (49.7 mph); maximum water speed 12 km/h (7.4 mph); maximum road range 900 km (559 miles); fording amphibious; gradient 60 per cent; trench not applicable; vertical obstacle not available

The 5000-kg (11,023 lb) capacity Bison is driven by two steerable Schottel propellers at speeds of up to 12 km/h (7.4 mph). As a private venture, the EKW Bison has yet to be ordered for military purposes, but development is complete.

Amphibious Vehicles in Vietnam

The very first regular American troops to set foot in Vietnam were Marines, and the LVTP5 saw extensive use. Nevertheless, there were many other designs which were tried out in the Delta and along the coast.

While helicopters played a major role in the war in Vietnam, the bulk of the fighting was carried out by infantry fighting on foot, although in many operations they were helicoptered to a point as near to their objectives as possible. In the coastal areas a wide variety of craft ranging from destroyers to Bell SK-5 hovercraft (and small junks and motorboats armed with light machine-guns) tried under the codename Operation 'Market Time' to stop the coastal infiltration of men and supplies from North Vietnam .

A wide range of craft, many of them armoured and heavily armed, were used to patrol the numerous inland waterways in South Vietnam. The rapid build-up of US forces in Vietnam meant that the existing ports could not hope to cope with the vast increase in required supplies, these ranging from fuel, food and ammunition to replacement vehicles and equipment. In the early days of the build-up ships would often lie off ports for days until berths became vacant. The 4×4 LARC (Lighter Amphibious Resupply Cargo) was widely used in South Vietnam to carry supplies from ships offshore onto the beach, where the valuable cargoes could be offloaded onto 6×6 trucks and taken further inland before being distributed to the individual units. If there were good roads near the beach the LARC-5s could take the cargo direct to supply dumps, so saving time and manpower in unloading.

It was originally thought that the M113 full-tracked armoured personnel carrier could not be employed in South Vietnam, but trials soon dispelled this belief. The M113 could easily propel itself across most of the area's inland waterways, but the main problem came when the vehicle tried to leave the water, as the banks were often very steep and the tracks of the M113 thus lost traction. This problem was solved by putting a capstan-type drum on each of the front-mounted drive sprockets; these were used in conjunction with two ground anchors and lengths of 30.48-m (100-ft) rope for self-recovery. Explosives were also used on occasion to blast away high banks. To overcome small rivers and streams, or to overcome very high banks, M113s fitted with a scissors-type bridge were also deployed in South Vietnam and used with some success.

Although the M113 could cross paddy fields, great efforts were made in the USA to design vehicles with a much lower ground pressure and therefore improved mobility over swampy and marshy terrain. One of the more interesting of these was the Pneumatic All-Terrain Amphibian (PATA) developed by the Ling-Temco-Vought company. This consisted of a central body which contained the V8 petrol engine, transmission, crew and cargo-carrying area. On each side of this were no less than 34 inflated air cells attached to an endless belt. This vehicle could carry 12 men (including its two-man crew) and had a very low ground pressure. It was not accepted for service.

To meet the requirements of the US Marines the XM759 Marginal Terrain Vehicle (MTV) was developed; this could carry 14 fully equipped troops or 1361 kg (3,000 lb) of cargo plus its two-man crew. Instead of conventional tracks this vehicle had 17 wide tyres attached to the track to give a low ground pressure. Trials with this system showed many shortcomings and the type was not built in quantity.

While helicopters were used to transport men and urgent supplies of food and ammunition from one base to another, most of the supplies had to go by road. In the wet season many of the roads in South Vietnam (especially in the central highlands) proved almost impassable to standard 6×6 trucks. In 1966 19 GOER 4×4 amphibious trucks were deployed to South Vietnam, and within 18 months these had carried some 9068 tonnes (8,925 tons) of stores and 6.44 million litres (1.7 million US gal) of fuel with an availability of over 85 per cent. These 19 vehicles were in fact six-year-old prototypes that had been stored in West Germany after trials. Following the successful use in South Vietnam of the GOER, the US Army placed an order in 1971 for 812 cargo trucks, 117 recovery vehicles and 371 tankers, and many of these remain in service today, although they are now

The Marines made numerous amphibious assaults on Vietnam, but the VC rarely obliged by resisting them. Here the LVTP5s lumber up the beach at the beginning of another attempt to trap the elusive guerrillas. The fearsome size of the LVTP5 was a handicap once ashore, and it proved hard to maintain and was vulnerable to mines.

being replaced by the 8×8 Heavy Expanded Mobility Tactical Truck.

Yet another vehicle developed for use in South Vietnam was the Chrysler Marsh Screw, which was powered by a Chrysler engine which via a transmission drove two large cylindrical screw-type pontoons on each side. This had a maximum speed in marshy terrain of about 22 km/h (14 mph), but caused severe damage to roads. The Soviet LFM-RVD-GPI-66 is very similar to the Marsh Screw, and is based on the GT-T tracked oversnow vehicle.

Left: Emerging from the surf like a mechanical sea monster, this is the LVTE5A1 engineer version of the LVTP5. Dubbed the 'potato digger' by the Marines, it could also fire a 927-kg (2,042-lb) demolition charge to clear minefields.

Above: The XM759 Marginal Terrain Vehicle was designed to cope with the swamps of South East Asia, the wide tyres attached to the track giving the necessary low ground pressure, but it was not a success.

JAPAN

Type 60 oversnow vehicle

The Japanese northern island of Hokkaido is often covered in snow, and this factor led the Japanese Ground Self-Defence Force to the procurement of two full-tracked oversnow vehicles, the **Type 60** and **Type 61**, both designed and built by the Komatsu Manufacturing Company and the Ohara Ironworks. The Type 60, which is also called the **Medium Snow Mobile**, has been designed to carry a total of 10 men (including the driver) or 900 kg (1,984 lb) of cargo, and to tow a trailer or weapon weighing 1500 kg (3,307 lb). The engine is at the front of the Type 60 and coupled to a manual gearbox with four forward and one reverse gear, while the suspension is of the bogie/torsion-bar type with eight dual road wheels, return rollers, drive sprocket and idler. The cargo area is at the rear and provided with a drop tailgate; it is normally covered with removable bows and a tarpaulin cover.

The Type 61 oversnow vehicle, also called the **Large Snow Mobile**, is similar in appearance to the Type 60 but can carry 1280 kg (2,822 lb) of cargo or tow a maximum load of 3200 kg (7,055 lb), and as such is often used to tow ski-fitted artillery such as the 105-mm (4.13-in) M101 which is the standard weapon of its type in the Japanese Ground Self-Defence Force. The Type 61 is powered by an Isuza DA-120T 6-cylinder water-cooled diesel developing 155 hp (116 kW), coupled to a manual gearbox with five forward and one reverse gear.

Specification
Type 60
Crew: 1+9
Combat weight: 3770 kg (8,311 lb)
Powerplant: one Toyota 6-cylinder water-cooled petrol engine developing 105 hp (78 kW)
Dimensions: length 4.07 m (13 ft 4.2 in); width 1.98 m (6 ft 6 in); height 2.05 m (6 ft 8.7 in)
Performance: maximum road speed 36 km/h (22 mph); maximum water speed not applicable; maximum range 135 km (84 miles); fording not known; gradient 60 per cent; trench 1.066 m (3 ft 6 in); vertical obstacle 0.5 m (1 ft 7.7 in)

Evolved from the civilian Komatsu KC-20 designed for use in the northern Japanese island of Hokkaido, the Type 60 was adopted in 1960 by the Japanese Ground Self-Defence Force, largely for use in the same location.

CANADA

Bombardier Snowmobile oversnow vehicle

The Industrial Division of Bombardier Limited of Quebec has for many years been involved in the design and production of a variety of tracked and semi-tracked oversnow vehicles for the civilian market. More recently it has undertaken production of some 2,000 M35 CDN 6×6 2½-ton trucks for the Canadian Armed Forces, and is building the West German Iltis 4×4 light vehicle for both the Belgian and Canadian forces. The very small **Bombardier Bombi** oversnow vehicle has been used by the Canadian Armed Forces as part of the United Nations forces operating in the Sinai desert, where the type's very low ground pressure makes it equally at home on sand as on snow. The **Bombardier Ski Doo Elite Snowmobile**, which can carry two passengers, has been tested by the US Marine Corps as a reconnaissance vehicle for possible use in Norway and elsewhere. The full-tracked **Bombardier Skidozer**, which is available with either a petrol or a diesel engine, is used by a number of countries in a military role, although it was not originally designed for this purpose.

The **Bombardier Snowmobile** oversnow vehicle is used by the Canadian Armed Forces in northern Canada as a general utility vehicle, and in appearance is very similar to a coach but the engine is at the rear and coupled to an automatic gearbox with three forward and one reverse gear. The front suspension consists of coil springs and hydraulic shock absorbers and is normally fitted with tyres, though these can be replaced by skis. The rear suspension on each side consists of four rubber-tyred road wheels on trailing arms, fitted with 420 mm (16.5 in) wide tracks which consist of rubber belts with steel crosslinks.

The personnel enter via a large door in the forward part of the vehicle, and there is also a door in the rear and an emergency roof hatch. Steering is of the power-assisted rack and pinion type, and standard equipment includes a heater and defroster, two fuel tanks, wing mirrors, front and rear lights, dry type paper air cleaner, block heater and full instrumentation.

Purchased by the Canadian Armed Forces for use in the wastes of northern Canada, the Bombardier Snowmobile, like many other such vehicles, was originally designed for civil rather than military use.

The Bombardier Bombi has found an unusual use for its abilities with the Canadian contingents of the UN forces in the Middle East, its low ground pressure being as suited to sand as to snow.

Specification
Bombardier Snowmobile
Crew: 1+11
Combat weight: 2337 kg (5,152 lb)
Powerplant: one Chrysler Model 318 V8 petrol engine developing 187 hp (139 kW)
Dimensions: length 5.38 m (17 ft 7.8 in); width 1.95 m (6 ft 4.8 in); height 2.06 m (6 ft 9 in)
Performance: maximum road speed 64 km/h (40 mph); maximum water speed not applicable; maximum range 320 km (199 miles); fording not known; gradient not known; trench not applicable; vertical obstacle not known

SWEDEN

Bv 202 tracked oversnow vehicle

The first oversnow vehicle used in any numbers by the Swedish army was the US Weasel, which was developed by Studebaker during World War II and used both in Europe and the Far East. By the mid-1950s these were becoming difficult to maintain and operate, so the Swedish army approached a number of national companies with a proposal to build a new vehicle. As none of them showed any real interest, the Swedish army itself built prototypes which were completed in 1958. These were followed by additional vehicles incorporating improvements as a result of trials with the original test rigs and prototypes. Once the design had been finalized, the complete production programme was put out to tender, and in 1961 Bolinder-Munktell was awarded the first production contract for the vehicle, which was called the **Bv 202**.

The Bv 202 remained in production for almost 20 years, final deliveries being made in 1981. In addition to those for the Swedish army, sales were also made to Finland, the Netherlands, Norway, Turkey and the UK. The last uses its vehicles for a wide range of roles such as command, cargo-carrying and towing the 105-mm (4.13-in) Light Gun on skis. The Royal Marines and Royal Artillery used the vehicle during the 1982 Falklands campaign, where it proved to be one of the few vehicles able to traverse the boggy terrain. In the Swedish army the Bv 202 is now being supplemented by the much improved Bv 206 built by Hägglund & Söner, although it will be many years before the older vehicle is phased out of Swedish service. The Bv 202 is also used for a number of civil roles in Sweden and countries where its low ground pressure enables it to cross with ease terrain such as swamp, mud and snow.

The Bv 202 consists of two units, front and rear, connected by an articulated joint. The front unit contains the engine, transmission, driver and commander, while the rear unit carries the load which can be 800 kg (1,764 lb) across country or 1000 kg (2,205 lb) on roads. The commander and driver are seated in a fully enclosed cab provided with a heater, but the rear unit has only a tarpaulin cover for the troops sitting on a bench seat down each side; if required, however, the rear unit can also be fitted with a heater. The vehicle is fully amphibious, being propelled in the water by its tracks.

When in production the vehicle was offered with a number of options such as a fully enclosed rear unit with stowage rack on top, a torque converter, a cold starting device and a tropical kit. Late-production vehicles had a slightly more powerful engine and a different transmission which gave a slight increase in carrying capacity on roads, and across country.

Naturally, Scandinavia has proved a fertile ground for the design of oversnow vehicles, with the Swedish Bv 202 being in service with several countries, including Turkey and the UK.

Specification
Bv 202
Crew: front unit 2 and rear unit 8
Combat weight: 4200 kg (9,259 lb)
Powerplant: one Volvo B18 4-cylinder petrol engine developing 91 bhp (68 kW)
Dimensions: length 6.172 m (20 ft 3 in); width 1.759 m (5 ft 9.3 in); height 2.21 m (7 ft 3 in)
Performance: maximum road speed 39 km/h (24 mph); maximum water speed 3.3 km/h (2 mph); maximum range 400 km (249 miles); fording amphibious; gradient 60 per cent; trench not available; vertical obstacle 0.5 m (1 ft 7.7 in)

A British Army Bv 202 comes ashore from an SRN-6 hovercraft on the coast of Norway. It was used effectively on the peat bogs of the Falkland Islands, where the low ground pressure was a great advantage.

SWEDEN

Bv 206 tracked oversnow vehicle

The **Bv 206** was developed from 1974 by Hägglund & Söner to meet the requirements of the Swedish army for a vehicle to replace the Bv 202 tracked oversnow vehicle. After trials with three batches of prototypes, the Swedish army placed an initial order for production vehicles in 1979, the first of them delivered in 1981. The Swedish army has a requirement for some 4,000 Bv 206s, and export orders have already been placed by Finland, Norway, the UK and the USA, while trials vehicles have been ordered by Canada and Italy. In the US Army the Bv 206 is known as the **Small Unit Support Vehicle M973**, and 268 vehicles have been ordered to replace the old M116 tracked oversnow vehicles which have been in service in Alaska since the 1960s.

Like the Bv 202, the Bv 206 consists of two units, front and rear, connected by a steering unit. The front unit contains the engine and transmission and has seats for five or six men, while the rear unit has seating for 11 men. When used in the cargo-carrying role, the Bv 206 can move a maximum of 600 kg (1,323 lb) in the front unit and 1400 kg (3,086 lb) in the rear unit.

The basic Bv 206 has fully enclosed front and rear bodies of fire-resistant glassfibre reinforced plastic. Each body unit is provided with a heater, which is essential in Sweden during the winter months. The basic vehicle is fully amphibious, being propelled in the water by its tracks. As an option the standard Ford V6 water-cooled petrol engine can be replaced by a Mercedes-Benz 5-cylinder inline turbocharged diesel developing 125 bhp (93 kW).

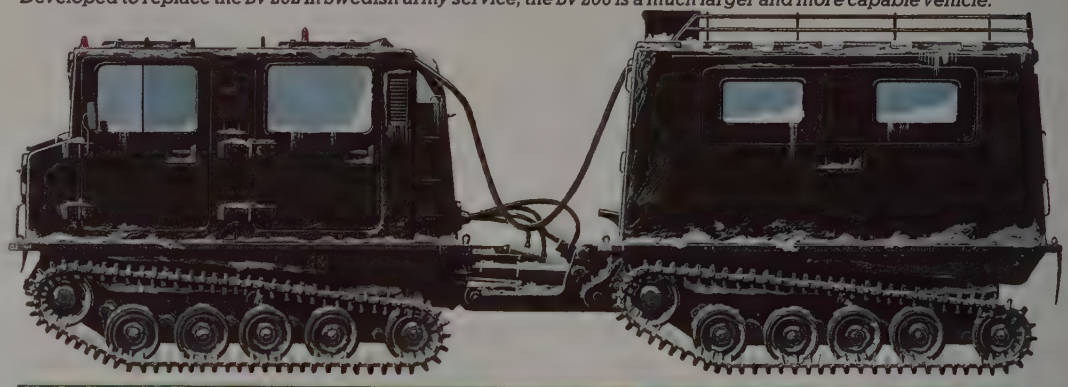
The anti-tank member of the family is the **Pvbv 2062**, which has an open-topped front body in which is mounted a Bofors 90-mm (3.54-in) recoilless rifle, the rear unit being used for ammunition. The front unit is provided with special roll-over protection bars which can be quickly lowered in action to allow the recoilless rifle to be used. In the future the 90-mm (3.54-in) recoilless rifle will be replaced by the Bofors BILL anti-tank guided missile, while for trials purposes the vehicle has already been fitted with the Hughes TOW anti-tank guided weapon, already used by the Swedish army. The command post version of the Bv 206 is the **Rabv 2061**, and this is fitted with extensive communications equipment. It has also been suggested that the Bv 206 could be fitted with the Swedish Giraffe surveillance radar (on a hydraulically-operated mast) for use in conjunction with the Bofors RBS 70 surface-to-air missile already fielded by the Swedish army.

Specification

Bv 206

Crew: front unit 5 or 6 and rear unit 11
Combat weight: 6340 kg (13,977 lb)
Powerplant: one Ford Model 2658E V6 petrol engine developing 136 bhp (101 kW)
Dimensions: length 6.86 m (22 ft 6 in); width 1.85 m (6 ft 0.8 in); height 2.40 m (7 ft 10.5 in)
Performance: maximum road speed 55 km/h (34 mph); maximum water speed 3 km/h (1.86 mph); maximum range 330 km (205 miles); fording amphibious; gradient 60 per cent; trench not available; vertical obstacle 0.5 m (1 ft 7.7 in)

Developed to replace the Bv 202 in Swedish army service, the Bv 206 is a much larger and more capable vehicle.



Above: The Bv 206 has been fitted with a variety of weapons, including a TOW anti-tank missile mount. It has been ordered by several nations, including the USA, UK, Canada and Italy.

Right: The Bv 206 can transport five or six men in the front section and up to 11 in the rear section. Total cargo capacity is 2000 kg (4,409 lb) in the two sections. Both sections are driven, but the engine and transmission is in the front.

In winter, the Bv 206 enters its element, its fully heated enclosed cabins ensuring crew comfort in the often bitterly cold northern Swedish climate. The Bv 206 is fully amphibious, being propelled in water by its tracks.

British Army Part 1

Despite all the many cutbacks and strictures of the past few decades, the British army is still a powerful military organization and it has demonstrated this fact on many occasions, the most recent being the Falkland Islands campaign (Operation 'Corporate') during 1982. That campaign has somewhat hidden the fact that the bulk of the British army's striking power is still maintained as part of NATO and is based in West Germany. There the army operates not as a national army but as part of a much larger European army that trains and acts as a deterrent to any potential aggressor. In this context the units based in the United Kingdom act only as supply and support units for the NATO-assigned forces, only a relatively small force being maintained for home defence. Other forces are still maintained in various parts of the world in what are very much relics of a bygone empire.

The Army in Germany

The army stationed in West Germany is some 52,000 strong and contains nearly all the main combat units of the service. The army in Germany is known collectively as the British Army of the Rhine (BAOR) and is divided into three main components. The main combat element is I (British) Corps, or I (BR) Corps, with its headquarters at Bielefeld. In support of I (BR) Corps is Rhine Area, which is the supply and support element for the corps, and in time of war Rhine Area would become the British Support Corps or BRSC. The third element is the Berlin Infantry Brigade, very much out on a limb and deep within Warsaw Pact territory but maintained there as part of 1945 treaty arrangements.

One of the main things to remember when studying the BAOR is that a good deal of its manpower and equipment strengths are maintained not in West Germany but in the United Kingdom. Nearly every unit in BAOR relies upon reinforcements of men (from the Territorial Army and Regular Reserves) to bring it up to full combat strength, and although there are large stockpiles of supplies and equipment maintained in West Germany at all times, still more would have to be brought over from the United Kingdom in an emergency. In this case the smooth transfer of men and equipment to I (BR) Corps would be the task of the BRSC.

The BAOR operates as part of NATO's Northern Army Group (NORTHAG) with the other NATO-assigned forces of West Germany, Belgium and the Netherlands. In time of peace all the four nations involved maintain their armies under national control and would only operate as a NATO force in an emergency. The only British army units involved with NORTHAG at all times are those of a single Royal Signals regiment.

In an emergency the manpower strength of NORTHAG would expand from about 200,000 to about 500,000. Some of this manpower growth would come from the reinforcements for the BAOR, for although the main striking force of I (BR) Corps consists of four divisions only three of these are actually based in the BAOR area and one of those maintains part of its strength in the United Kingdom.

I (BR) Corps consists of three armoured divisions, one infantry division, an artillery division and corps troops (divided into arms and services). The armoured divisions are the 1st, 3rd and 4th Armoured Divisions, all of which are based in West Germany; the 2nd Infantry Division is based in the United Kingdom, headquartered at York, and it would have to be moved to Germany in an emergency. Each of the divisions, armoured and infantry, has three brigades, and one of the 3rd Armoured Division's brigades (19th Infantry Brigade) is maintained in the United Kingdom at Colchester so it too would have to make its way to Germany if required.

Widely respected for its professionalism and efficiency, the British army deploys its main strength in Germany as part of NATO's Northern Army Group. The infantry regiments are equipped with FV432 armoured personnel carriers, seen here behind Ferret armoured cars.

The brigades are either armoured or infantry and the exact make-up of a brigade depends on its operational role in time of war. Of the four divisions two would act as forward units (the 1st and 4th Armoured Divisions) and another would act in support of these two (the 3rd Armoured Division). Each of these divisions would be made up mainly from armoured brigades (each with one or two armoured regiments) and one or two mechanized infantry brigades, with the preponderance of armour forward. The 2nd Infantry Division has three infantry brigades, two of them being Territorial Army brigades.

Having outlined these administrative guidelines, it now has to be said that in time of war all these tidy distinctions would be laid inside a much less defined organization based on the divisions, which would then break up into a number of task forces, battle groups and combat teams. Each armoured division has within its organization three armoured brigades, a reconnaissance regiment, three artillery regiments, an engineer regiment, an Army Air Corps regiment, and transport, medical, stores support, repair and provost units. All these units are divided up and assigned into battle groups, although some units (medical, supply and comparable units) would stay under division control. The main problem is that each battle group is formed to meet a particular operational requirement or objective and thus no two are the same. In theory each battle group is formed from a balanced grouping of armour, infantry and artillery with engineer and signal support, but in some instances local preponderances of one arm or another are bound to occur. For example, in a forward area much of the battle group will be made up from armour while in a rear area there might well be more infantry. In some areas battle groups or combat teams (two or three of which form a battle group) may well be mainly made up from anti-tank defence weapons, but it must be stressed that this is dependent purely upon local conditions and the manner in which the local commander sees fit to conduct his task.

The main I (BR) Corps operational area can be defined as a strip of land extending from a line drawn east of Hannover down to the Harz mountains in the

Protected by Chobham armour and mounting the trusty L11A5 120-mm rifled gun, the FV4030/4 Challenger is one of the most powerful main battle tanks in the world, but at the time of writing only one armoured division is scheduled to receive them.

south, and extending eastwards to the Inner German Border (IGB) between East and West Germany. To the rear of I (BR) Corps and back to the Channel is the domain of Rhine Area/BRSC, and the 2nd Infantry Division would be used to maintain and guard the supply lines to I (BR) Corps through this area.

Not all of I (BR) Corps troops would be assigned to the divisions. Under direct corps control is the artillery division, which has a long-range general support regiment (armed with 175-mm/6.89-in M107s), a missile regiment (armed with the nuclear Lance missile), a heavy regiment (armed with 203-mm/8-in M110 howitzers, also with a nuclear capability), two Rapier-armed light air defence regiments (with a mix of Tracked and Towed Rapiers), and a locating regiment. Corps troops include an amphibious engineer regiment (equipped with the M2 floating bridge and ferry), an armoured engineer regiment (equipped with Centurion AVREs and Chieftain AVLBs), two corps signal regiments and a special corps Army Air Corps squadron. To these must be added a whole retinue of various service units.

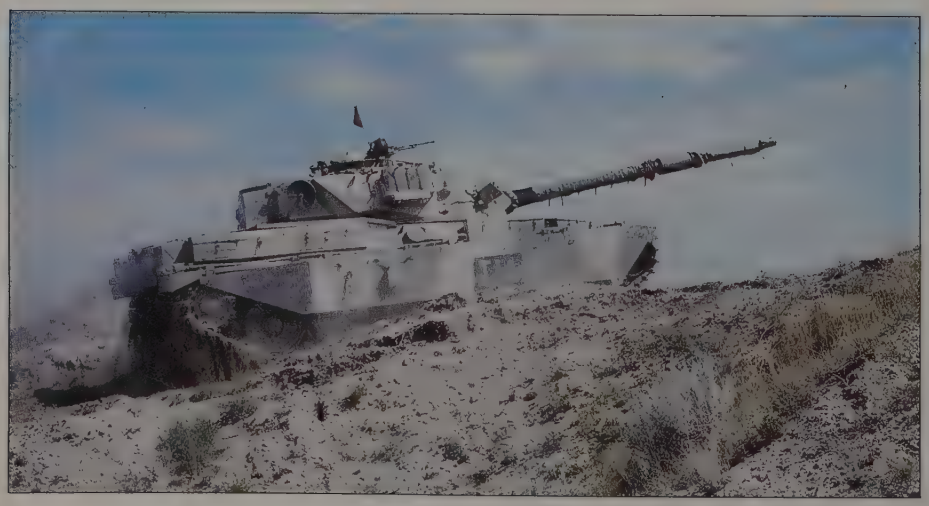
In Berlin the Berlin Infantry Brigade is made up of three infantry battalions and a single armoured squadron. In an emergency it would have a holding role only and would not expect to be reinforced.

The United Kingdom

For the army the United Kingdom acts as its main recruiting area, its training centre and as its main supply and support centre. Only a relatively small number of units are assigned to home defence as the national executive has decided that the best place to defend the nation is on the European continent, and thus in an emergency nearly all units and manpower would decamp for Germany. To maintain this situation the United Kingdom is divided into a number of districts, each with its administrative tasks of seeing to the day-to-day functions of all the establishments and units within its area, be they Regular Army or Territorial Army.

Within the United Kingdom three brigades are maintained at all times as part of the 2nd Infantry Division for BAOR (these are the 24th Infantry Brigade, the 15th Infantry Brigade (V) and the 49th Infantry Brigade (V), both the latter being TA brigades. To these must be added three more brigades; the first of these is the 19th Infantry Brigade, which is assigned to the 3rd Armoured Division in BAOR. The second is the 1st Infantry Brigade, which has two functions: the NATO central reserve and the basis for the United Kingdom component of the NATO Allied Mobile Force (Land) or AMF(L), which is a multi-national force intended for use on either of the NATO flanks in Norway or Turkey. The third UK-based brigade is the 5th Infantry Brigade, which is designed for the home defence of the United Kingdom but which took part in the Falkland Islands campaign of 1982. Other brigades are administrative only and are maintained by the various district headquarters. One of the district headquarters, the North East District at York also doubles as the headquarters for the BAOR's 2nd Infantry division, though a forward headquarters for this division is maintained at Lubbecke.

In service since 1967, the Chieftain will continue to provide the bulk of British tank strength for many years to come. Heavily armoured and also equipped with the L11A5 120-mm gun, Chieftains are currently being retrofitted with the Improved Fire Control System.



The United Kingdom acts as the main training base for the army. Nearly all the army's basic, trade, officer and other training is carried out in the United Kingdom, and the personnel from the various training establishments would make up much of the home defence personnel in an emergency. Most of the army's main supply, repair, research and development facilities are also based in the United Kingdom. The main administrative and policy sections are based in London and its environs while large training areas are centred around Salisbury Plain, the Aldershot area, Catterick in the north and several other areas well known to generations of soldiers.

The Army abroad

The British army still maintains sizable numbers of soldiers at various locations overseas, the main strength currently being in the Falklands. The army's main manpower contribution to the Falklands is now past, but about three infantry battalions plus artillery, engineer, reconnaissance, Army Air Corps and other elements are still maintained there. Once the new airport at Mount Pleasant is complete it is expected that these levels will fall to a much lower total.

Northern Ireland is hardly overseas but it is still a constant drain on the army's manpower resources, even though the local police forces have now assumed many responsibilities once maintained by the army. There the army has established the Ulster Defence Regiment (some 7,100 strong and organized into 11 battalions to undertake many of the army's routine duties) but a number of infantry and other battalions (variable according to the local state of tensions) are on duty there at any one time.

An infantry battalion is maintained in Gibraltar, and in Belize in Central America a mixed force of infantry, artillery, Army Air Corps, engineer and other troops is based to maintain the sovereignty of what was British Honduras. In Cyprus two weak infantry battalions plus the usual support forces are used to guard the British Sovereign bases; these also act as part of the United Nations Force in Cyprus (UNFICYP). A small force also works with the United Nations in Sinai. Away to the east in Hong Kong the army has a single infantry battalion plus four Gurkha battalions with another Gurkha battalion in Brunei. The Gurkhas are very much part of the British army still, and have a battalion based in the United Kingdom; they also have their own engineers, signals and transport squadrons, and one of the Gurkha engineer units is based in the United Kingdom at regimental strength.

The army also maintains large training areas in Kenya and Canada. The Canadian area at Suffield in Alberta is large enough for almost unlimited live firing exercises to be held. This facility is used for the training of battle groups from BAOR.

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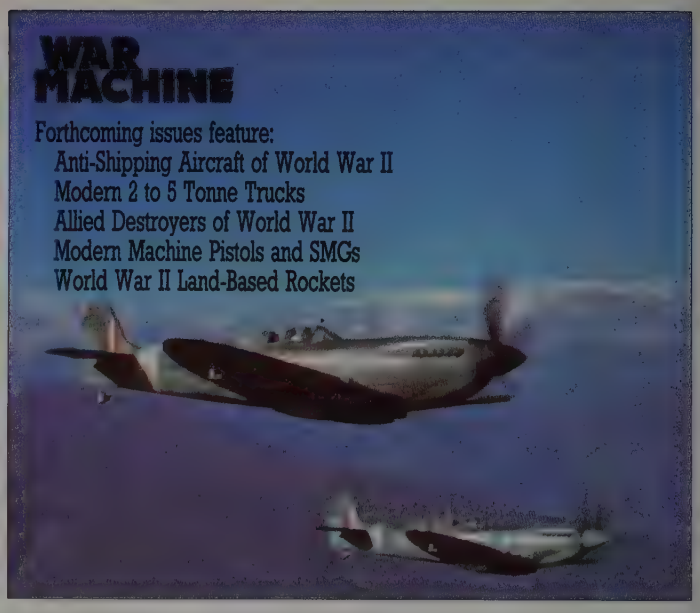

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Modern Air to-Ground Weaponry

Typical of modern combat aircraft, the Dassault Mirage 2000 is capable of carrying a wide range of weapons, including bombs, cluster bombs, unguided rockets and air-to-surface and air-to-air missiles.

By far the largest proportion of the strength of modern air forces is dedicated to what American planners have called the 'Air-Land Battle', providing assistance to allied ground forces and interdicting the enemy. To be effective, air arms have to be able accurately to deliver sophisticated weaponry.

Air-to-surface weaponry encompasses a wide variety of types ranging from the simple, relatively inaccurate mass-produced cheap 'iron' bomb, through unguided air-to-surface rockets to the highly sophisticated, very accurate and extremely expensive precision-guided munitions such as the air-to-surface missile and the guided bomb. It also includes such weapons as the various types of cluster bombs designed to carry large numbers of small bomblets or mines for use against area targets, and the new dispenser weapons to be carried under the fuselage of the Panavia Tornado strike aircraft.

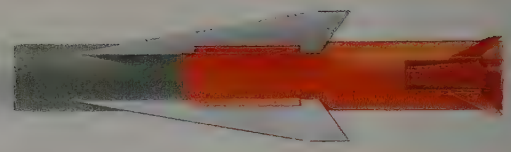
In assessing the capabilities of the world's air forces and their inventories of these weapons, it rapidly becomes apparent that only relatively few nations have available the complete spectrum of air-to-surface weapons, and that even some of the larger nations, such as Communist China, seem to be fairly backward in the types they have have in service. Both the USA and the USSR are very well equipped, whilst the Royal Air Force is poorly equipped, the more so when one considers that a weapon such as a cluster bomb is fairly cheap to design and build, or even to buy 'off the shelf' from another nation. Moreover, an increasing number of modern precision-guided weapons with stand-off capability are needed today just to reduce the anticipated losses of strike aircraft committed against such sophisticated air defences as the Soviets currently have available. If the present Ministry of Defence planning in this field for the Royal Air Force remains unaltered, the service will not be able to meet all its conventional NATO target commitments and would almost certainly lose significant numbers of its aircraft during overflights to deliver fairly outmoded weapons. The Falklands war was a severe lesson in this respect, as all the BAe Harrier and Sea Harrier combat losses were to Argentine air defences that are minimal in comparison with those that must be anticipated in attacks on a Warsaw Pact airfield, or even a target just behind the main battle zone.

Israel has vast combat experience derived from her Middle East wars and has realized that a wide variety of weaponry is required to meet the requirements of specific occasions, especially as she considers that the lives and experience of her pilots are of paramount importance.

An American Boeing B-52H is seen dispensing retarded bombs at low level. Such flying is essential in the face of modern air defences, and the weaponry must be slowed to enable the aircraft to escape the blast.

FRANCE

Aérospatiale AS.30 and AS.30 Laser



The AS.30 has been operational for nearly 25 years, and in that time has seen a continual enhancement of its capability. With its Mach 1.5 speed, the AS.30 has a range of some 11.25 km (7 miles).

Essentially a scaled up AS.20, the **Aérospatiale AS.30** started life in 1958 as the **Nord 5401**. In 1960 the basic AS.30 was fielded aboard the Dassault Mirage III fighter-bomber to meet a French air force requirement for an air-to-surface missile (ASM) that could be launched without the carrier coming within 3 km (1.86 miles) of the target. With a range of over 10 km (6.2 miles) and a terminal CEP of less than 10 m (32.8 ft), the original version required the operator to keep the missile aligned on the target with a joystick and tracking flares on the rear of the missile's body; a radio link was used to transmit corrective guidance commands to the onboard autopilot for course corrections. In 1964 an improved variant with a TCA semi-automatic guidance system and new flip-out fins entered production and service only for the French air force. This **AS.30 TCA** employs a SAT tracker unit for the continuous monitoring of an IR flare on the missile's rear, the pilot having only to keep the target centred in his attack sight. Over 3,870 AS.30s were built for a number of nations, operators being France, India, Israel (now out of service), Peru, South Africa, Switzerland, UK (now out of service) and West Germany. Of these South Africa has used the missile under operational conditions to attack and damage the abandoned and drifting oil tanker *Wafra* off her coastline, the launch aircraft in this case being the BAe Buccaneer S.Mk 50.

To enhance the weapon's capabilities into the 1990s, Thomson-CSF and Aérospatiale began work in 1974 on a laser-guided version. The target designation pod is the Automatic Tracking Laser Illuminator System (or Atlis), whilst the laser seeker head is called Ariel. By 1980 the first homing trials with pre-production rounds were under way, and in late 1983 the first deliveries of production **AS.30 Laser** rounds were made to the French air force for use on its SEPECAT Jaguar fighter-bombers, and several other as yet unidentified countries have since adopted the type.

Specification

AS.30 series
Type: air-to-surface missile
Dimensions: length (AS.30) 3.839 or 3.885 m (12 ft 7.1 in or 12 ft 9 in), or (AS.30 Laser) 3.65 m (11 ft 11.7 in); span 1.0 m (3 ft 3.4 in); diameter 0.34 m (13.4 in)
Launch weight: 520 kg (1,146.4 lb)
Propulsion: solid-propellant rocket motor
Performance: speed Mach 1.5; range 11.25 km (7 miles); CEP (AS.30 and AS.30 TCA) less than 10 m (32.8 ft) or (AS.30 Laser) about 2.0 m (6.6 ft)
Guidance: AS.30 manual, AS.30 TCA semi-automatic to line-of-sight, and AS.30 Laser laser-homing
Warhead: 240-kg (529-lb) HE with impact or delay-action fusing

An AS.30 Laser is seen mounted on a SEPECAT Jaguar during the first homing trials for the system. With laser guidance the latest AS.30 is accurate to within 2 m (6 ft 6 in), as compared to the earlier version's accuracy of 10 m (32 ft 9 in).

FRANCE

Aérospatiale ASMP

Right: The large ASMP (medium-range air-to-surface missile) weighs 1000 kg (2,205 lb) at launch and can travel at speeds of up to Mach 4.

The **Aérospatiale ASMP** (Air-Sol Moyenne Portée, or medium-range air-to-surface missile) is due to become France's main air-delivered nuclear weapon. It is powered by a liquid-fuel ramjet system and will be used mainly against tactical targets such as road and railway bridges, transport depots, and command, control and communications facilities. It will also have a semi-strategic role against hardened targets, and for this a total of 16 Dassault-Breguet Mirage IVA bombers of the Force de Frappe are being converted to the Mirage IVP configuration to carry one round under the fuselage in place of the current AN22 60/70-kiloton yield free-fall nuclear bomb. The first of two squadrons to operate the Mirage IVP will commission in 1987.

For the tactical role with the ASMP the French air force is procuring 85 Dassault-Breguet Mirage 2000N two-seat low-altitude strike fighters, which from 1988 onwards will initially supplement and then replace the SEPECAT Jaguars at present assigned to this mission with single AN52 15-kiloton yield free-fall bombs. The French navy is also converting approximately 50 of its carrier based Dassault-Breguet Super Etendard fighters as launch platforms.

Missile guidance is of the preprogrammed inertial type with several flight profiles available. In general terms these profiles are believed to be similar to those available to the American AGM-69 SRAM. A total of 100 operational rounds is to be procured for the two services, and these will replace the majority of the free-fall nuclear bombs now held in stock.

Specification

ASMP
Type: tactical and/or semi-strategic air-to-surface missile
Dimensions: length 5.38 m (17 ft 7.8 in); span not known; diameter 0.96 m (3 ft 1.8 in)
Launch weight: 1000 kg (2,205 lb)
Propulsion: liquid-fuel ramjet
Performance: speed Mach 4; range 300 km (186 miles); CEP not known
Guidance: inertial
Warhead: 150-kiloton yield nuclear

Scheduled to replace most free-fall nuclear bombs in French service, the ASMP missile will be mainly delivered by the strike version of the Dassault Mirage 2000, and by remaining Mirage IV bombers. Super Etendards will also be fitted to operate ASMP.

SWEDEN

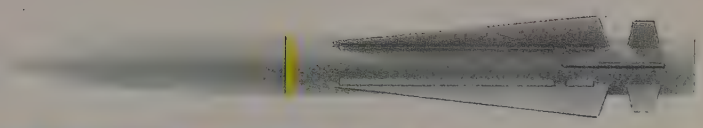
Saab-Bofors Rb05A

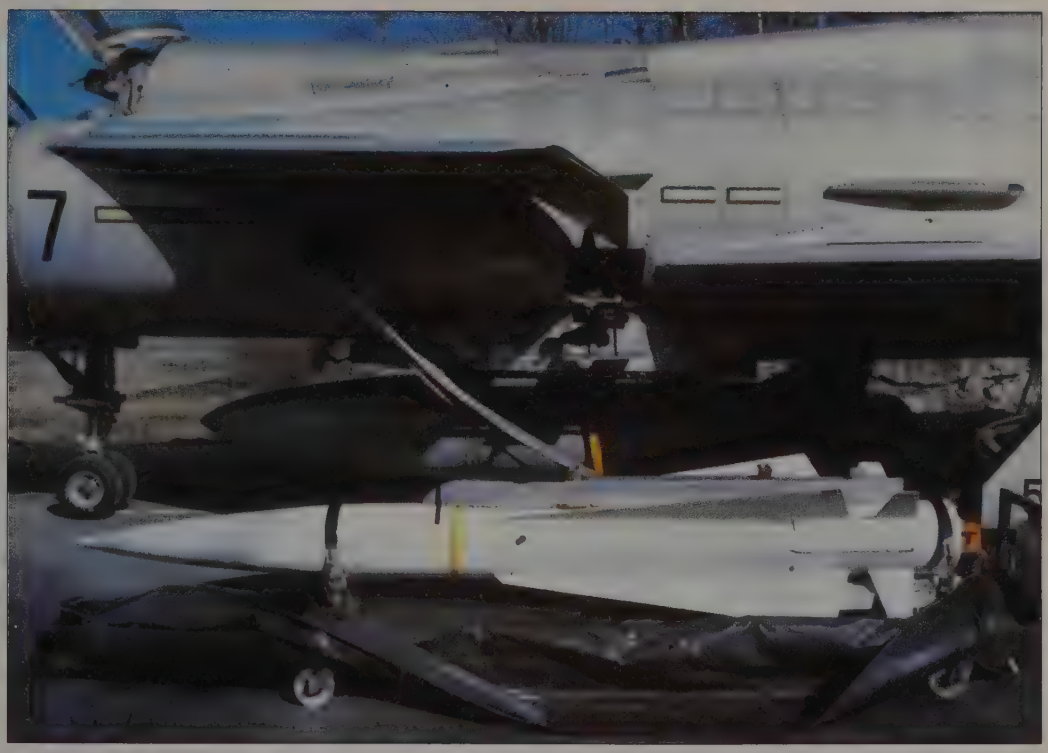
The **Saab-Bofors Rb05A** is a simple, manually-controlled radio-command weapon for carriage on a wide variety of launch platforms. It is intended mainly for use against land and sea targets, but it may also in certain circumstances be used in an air-to-air role against such targets as a hovering helicopter. The airframe consists of a pointed cylindrical body with long-chord cruciform wings and aft-mounted cruciform control surfaces. A liquid-propellant rocket motor is centrally located, and the electrical preheating of the round is undertaken by the carrier platform.

Once the missile has been launched from a height of 20-50 m (65-165 ft), the aircraft climbs to around 300-400 m (985-1,310 ft) and the pilot manually guides the weapon by lining it up on the target with the visual aid of rear-mounted tracking flares. Any control signals required are passed to the Rb05A via the radio link to the missile's onboard receiver. Once the missile is in the target's vicinity, a proximity fuse detonates the HE blast-fragmentation warhead.

The Rb05A is used by the Swedish air force's Saab AJ37 Viggen attack and Saab 105 light strike and trainer aircraft. Production started in the early 1970s and ceased in 1977. A more sophisticated version, the **Rb05B** with electro-optical TV homing, was to have been built, but this was cancelled when the Swedes bought the Hughes AGM-65A Maverick in its place.

Right: Armed with an HE blast fragmentation warhead, the Mach 1+ Rb05A missile may be used in a limited air-to-air role as well as in its primary function as a tactical air-to-ground weapon.





Arming the Saab AJ37 attack aircraft, the Rb05A is a relatively simple missile, steered manually by radio command. The pilot of the aircraft tracks the missile visually after release, guidance being made easier by flares in the missile tail. The warhead has a proximity fuse.

Specification
Rb05A
Type: air-to-surface missile
Dimensions: length 3.60 m (11 ft 9.7 in); span 0.80 m (2 ft 7.5 in); diameter 0.30 m (11.8 in)
Launch weight: 305 kg (672.4 lb)
Propulsion: liquid-propellant rocket
Performance: speed Mach 1+; range 9 km (5.6 miles); CEP less than 10 m (32.8 ft)
Guidance: manual radio command
Warhead: HE blast fragmentation

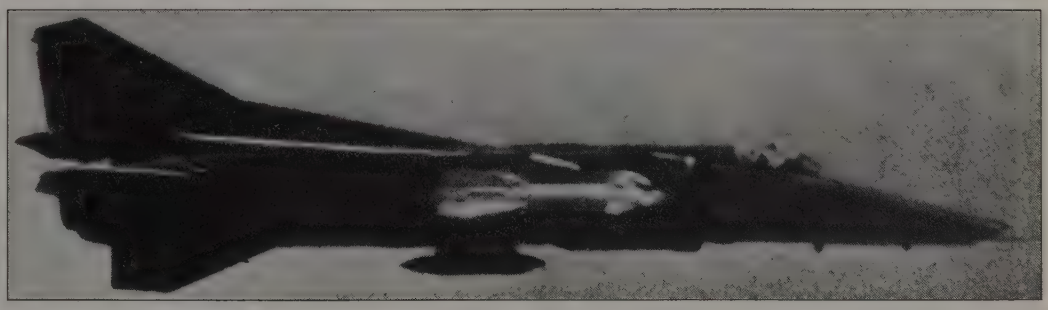
USSR

Soviet tactical air-to-surface missiles

It is notoriously difficult to obtain any reliable data on Soviet weapons of any description unless they have been captured. However, in the area of tactical air-to-ground weapons it is known that the Soviets have paralleled many of the Western equipment types, and in some specific areas such as fuel-air explosive munitions have gained a real lead in development.

The early Soviet tactical ASMs never received NATO reporting names, but from American sources it has been discovered that they were physically based on air-to-air missiles. The first real ASM to be seen by NATO was given the designation **AS-7 'Kerry'**. This entered service in the late 1970s with both the Soviet air force and navy, and is a single-stage radar beam-riding solid-propellant missile equivalent to the much earlier American Bullpup series. This was followed by the **AS-8**, which is a fire-and-forget anti-tank weapon for the Soviet attack helicopters such as the Mil Mi-24 'Hind', and perhaps the Sukhoi Su-25 'Frogfoot' battlefield support aircraft. The **AS-9** was the next in the sequence, and this is reported to be a comparatively large turbojet-powered supersonic anti-radiation missile (ARM) with a range of 100 km (62 miles) and a warhead of 150 kg (331 lb) for use by bombers and strike aircraft in penetrating air defences. The more recent **AS-11** and **AS-12** are said to be improved versions of this missile with different homing heads and increased performance. The intervening weapon, the **AS-10**, is a Mach-1 solid-propellant missile with electro-optical homing, a range of 11.1 km (6.9 miles) and a 100-kg (220-lb) warhead. The last missile for which details are available is the **AS-14** (formerly known to NATO as the **Advanced Tactical ASM**). This is a larger version of the AS-10 with mid-course guidance and the electro-optical homing system used for the terminal phase of its maximum 40-km (25-mile) flight trajectory. Recent photographic evidence has shown it under the wings of a Mikoyan-Gurevich MiG-27 'Flogger-J' fighter-bomber.

The Soviets also have laser-guided versions of their standard FAB-500, FAB-750 and FAB-1000 GP low-drag iron bombs, together with versions of the 210-mm (8.27-in) S-21 and 325-mm (12.8-in) S-32 air-to-surface unguided rockets that have been fitted with limited visual-guidance systems. These supplement the vast array of conventional weapon types deployed by the Soviets.



The AS-14 is one of the most advanced tactical missiles in service with the Soviets for which any information is available in the west. Carried by the MiG-27 'Flogger-J', it is thought to have an electro-optical guidance system with mid-course correction.

Dimensions: not known
Launch weight: 1200 kg (2,646 lb)
Propulsion: solid-propellant rocket motor
Performance: speed Mach 1; range 11.1 km (6.9 miles); CEP not known
Guidance: radar beam-riding
Warhead: 100-kg (220.5-lb) HE blast fragmentation

Specification
AS-7 'Kerry'
Type: air-to-surface missile

Soviet strategic air-to-surface missiles

At present the strategic elements of the air armies of the Soviet Union use strategic variants of the **AS-3 'Kangaroo'**, **AS-4 'Kitchen'** and **AS-6 'Kingfish'** ASSMs. The Soviets also use versions of the last two missiles with passive radar-homing systems to destroy radars assessed as being of prime importance in the defence of targets likely to be attacked by Soviet strategic bombers.

Of the three listed systems only the AS-3 was developed solely for the strategic mission, the others also being available in anti-shipping variants for use by the Soviet naval air force. The 'Kangaroo' was based on an aircraft airframe with turbojet propulsion. The guidance is handled by an autopilot with mid-course command-correction facilities; no terminal homing system is fitted, and this lack of terminal accuracy dictates the use of an 800-kiloton yield thermonuclear warhead. The range is 650 km (404 miles) using a high-altitude supersonic flight profile before a terminal dive at the target location. Carried only by the Tupolev Tu-95 'Bear-B' and 'Bear-C' four-engine long-range bombers, the AS-3 is gradually being replaced by the AS-4 (carried by the 'Bear-G' conversion) and by the **AS-X-15**. This latter is carried by the new-production 'Bear-H', which can launch a number of the low-altitude AS-X-15 cruise missiles, which each have a range of 3000 km (1,865 miles) and a 200-kiloton yield warhead.

Both the Mach-3.5 AS-4 and the Mach-3.0 AS-6 are single-stage solid-propellant missiles. The AS-4 is inertially guided to its target, whereas the AS-6 has an autopilot guidance system. In the normal high-altitude flight profile the AS-4 has a range of 460 km (286 miles) and the AS-6 of 560 km (348 miles) with very steep terminal dives. In both case the missiles can be used on a low-altitude profile, which reduces their ranges to 300 km (186 miles) and 250 km (155 miles) respectively. The nuclear warhead carried by both is of 350-kiloton yield, although this may be exchanged for a 1000-kg (2,205-lb) HE warhead if required.

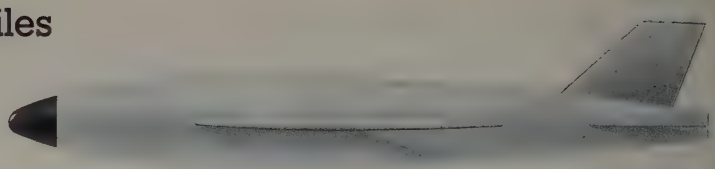
The strategic forces also use the **AS-5 'Kelt'** on occasion with their medium bomber units. Thought to be used in this context with a passive radar-homing seeker for defence-suppression tasks, the 'Kelt' carries only a conventional 1000-kg (2,205-lb) HE warhead. It is a Mach-1.2 liquid-propellant rocket-powered winged missile with high- and low-altitude flight profile ranges of 230 km (143 miles) and 180 km (112 miles) respectively. According to Israeli sources, the terminal dive angle is very shallow and the weapon can easily be engaged by air-defence systems.

Further strategic air-launched strategic missiles of higher performance are known to be in development. Of the current weapons the USSR uses all, while the conventionally-armed AS-4 is used by Iraq, and the AS-5 by Egypt and Iraq.

Specification

AS-3 'Kangaroo'

Type: air-to-surface strategic missile
Dimensions: length 14.90 m (48 ft 10.6 in); span 9.14 m (30 ft 0 in); diameter 1.85 m (6 ft 0.8 in)
Launch weight: 11000 kg (24,250 lb)
Propulsion: one turbojet
Performance: speed Mach 1.8; range 650 km (404 miles); CEP not known
Guidance: autopilot with mid-course correction
Warhead: 2300-kg (5,071-lb) nuclear with a yield of 800 kilotons



Right: The AS-5 'Kelt' bears a family resemblance to the AS-1 'Kennel', with the major change being from jet to rocket power. In place of the jet intake, the AS-5 has the nose (and probably guidance system) of the 'Styx' shipborne SSM.

Above: Carried in pairs by the Tupolev Tu-16 'Badger', the AS-5 has been supplied to various Soviet clients operating the aircraft. The 8.59 m (28 ft 2 in) missile has a 1000-kg (2,205-lb) high explosive warhead.

Below: Most potent aircraft in the Soviet inventory, the Tupolev Tu-22M 'Backfire' is mainly armed with the supersonic AS-4 'Kitchen' both for the strategic and the anti-shipping roles.

Modern Free-Fall Bombs

The startling development of precision guided missiles since the end of World War II might have led many to suppose that the day of the old fashioned 'iron bomb' was done. That the truth is very different is a reflection of the multitude of different types of target confronting an attacking aircraft in modern warfare.

As most nations not in the Soviet bloc tend to use American-designed and American-built 'iron' bombs their development will be reviewed first.

In the immediate post-war period a proposal was received by the then Bureau of Aeronautics to revise the US Navy's existing bomb inventory to give a series of streamlined low-drag bombs that would be suitable for carriage by future generations of supersonic aircraft envisaged at the time. As the subsequent BuAer design concept was too long, the proposing company (Douglas) chose an Aero 1A shape with a length:diameter ratio of 8.3:1 and applied it to give the familiar Mk 80 series of general-purpose (GP) bombs, namely the 113.4-kg (250-lb) Mk 81, the 227-kg (500-lb) Mk 82, the 454-kg (1,000-lb) Mk 83 and the 907-kg (2,000-lb) Mk 84.

Meanwhile the US Air Force took its existing 340.2-kg (750-lb) bomb and modified it with a new streamlined tail to give the M117 Demolition Bomb. During the same period the Air Force produced the similar 1360.8-kg (3,000-lb) M118. These two bombs had thinner casings than the US Navy models and thus produced their effects by blast rather than fragmentation.

In the late 1950s and as part of the development of weapons for use in the periodic 'brushfire' wars in the world, the US Naval Weapons Center at China Lake began development of a series of unguided conventional weapons that had 'eye' series codenames. One of these was the Snakeye fin retarder for Mk 81 and Mk 82 bombs; this permitted the bombs to be carried by aircraft at high speed and then dropped at very low altitudes without destroying the plane in the subsequent blast. It achieves this effect by deploying several air-brake surfaces to slow the bomb's downward motion to a significant degree. However, even after years of use with the US forces, the Snakeye system is considered to be unreliable. For the longer term an Advanced General-Purpose bomb is under study for use by the US Navy in three sizes: 226 kg (500 lb), 454 kg (1,000 lb) and 907 kg (2,000 lb). The smallest bomb size has been discarded as it is considered too light for a modern battlefield and its targets. The US Air Force may well use these bombs (as it did eventually the Mk 80 series) but instead seems to be veering towards the continued use of its old iron bombs (at least until current stocks are exhausted) but upgrading them into precision-guided munitions and supplementing them with new-build glide-bomb systems.

Although the Cluster Bomb Unit (CBU) munition was in service as early as World War II, the US Navy generally neglected its development during the first post-war decade. In sharp contrast the US Air Force moved into this field in a big way as it concluded that such weapons were particularly useful in enabling individual aircraft to make multiple kills of scattered targets on a single pass through intense ground fire. Thus the US Navy designed only a few of these weapons, of which the Mk 20 Rockeye II anti-armour cluster bomb is perhaps the most familiar as it has been used by Israel in combat during the 1973 'Yom Kippur' War and the 1982 invasion of Lebanon; the type entered service with the US Navy in 1968.

The US Air Force has assigned at least 92 CBU numbers to munitions, although not all of these have entered service. The latest conventional CBU with instantaneous effect submunitions to have entered production is the CBU-87/B Combined Effects Munition which contains 202 bomblets in a SUU-64/B dispenser. Each bomblet has a shaped charge, a fragmentation section and an incendiary device. A considerable number of the CBUs designed and built found use in the Vietnam War (such as the CBU-19A/B and CBU-30/A which used CS tear gas bomblets, and the CBU-52/B with fragmentation bomblets) in the air-defence suppression role by literally smothering a site with the bomblets.

In Europe the UK generally followed the US Air Force's lead after World War II by using slightly modified versions of its World War II

Perhaps the greatest change to have occurred in recent years has been the virtual disappearance of the bomb bay from tactical aircraft. Even the General Dynamics F-111, although having a small weapons bay, was designed to carry massive loads of ordnance on underwing hard points.

The external carriage of stores can produce significant aerodynamic drag, considerably degrading aircraft performance. The modern free-fall bomb is much more streamlined than its predecessors, assisting aircraft such as the Grumman A-6 Intruder.

The old-style heavy bomber still exists in the shape of the Boeing B-52. The massive bomb load, up to 24500 kg (54,000 lb), was used to devastating effect in the Vietnam War, enormous tonnages being dropped on the North.

bomb stocks. The advent of fast jets required new weapons, however, resulting in the current 244.9-kg (540-lb) and 454-kg (1,000-lb) medium-capacity bombs which eventually gained tail retarding devices designed for the same function as the Snakeye. All these weapons are in widespread British use and have been exported, as is testified by the Argentine use of the 454-kg (1,000-lb) model against the Royal Navy during the 1982 Falklands war. However, unlike the Americans and their prodigious development of CBUs, British interest since the late 1960s has centred on only one weapon in this category, the BL-755 or Cluster Bomb Mk 1, which entered service with the Royal Air Force in the early 1970s as an anti-armour weapon. Used in the Falklands war as an area weapon against airfield facilities, troop concentrations and supply dumps, it proved relatively successful although a greater choice of submunition types would have been welcome. An improved version, with capability against the latest Soviet armour, is now being procured. In direct comparison with what is available to American forces and the air forces of some other nations, such as France and Israel, the Royal Air Force's current capabilities in the free-fall bomb field are at best questionable.

France, with its manufacturers Thomson-Brandt and Matra and their range of weapons from CBUs to cratering bombs, seems to have a better grasp than MoD planners of the munition types required for use in the modern battlefield. In fact it was Israel, with France's help, that developed and subsequently used the 'concrete-dibber' type of rocket-powered bombs: in the 1967 Six-Day War against the Egyptians the Israelis closed a number of the enemy's airfields by causing severe crater damage beneath the runway surface as a result of the bombs' tunnelling effects. The next use of such a weapon was during the 1971 Indo-Pakistan War, when bombs of a similar type with the Soviet designations BETAB-250 and BETAB-500 were dropped by Indian Air Force Mikoyan-Gurevich MiG-21s and Sukhoi Su-7s.

During the numerous conflicts that the Soviet client states have fought, and in the current Soviet operations in Afghanistan, a comprehensive array of free-fall bombs and cluster munitions has been used. The Soviets' latest narrow-body free-fall low-drag GP bombs are designated FAB-100, FAB-250, FAB-500, FAB-750 and FAB-1000 (the number indicating the weapon's notional weight in kilograms), and the Egyptians have revealed that the Soviets use tail-mounted retarding devices for the FAB-250 and FAB-500 models that are similar in design to the American Snakeye. Fragmentation versions of these two bombs also exist with the designations OFAB-250 and OFAB-500. There is also a series of incendiary bombs (but not napalm tanks) that corresponds in size to the FABs but allocated the prefix ZAB. Cluster munition designations are more difficult to discover, although it is known that ZAP-200, PTK-250, RPK-180, RPK-250 and RRAK all refer to such weapons. The cluster weapon has been extensively used in Afghanistan, especially with a parachute retarding device in order to achieve safe low-altitude delivery and dispensing. It is also known that various fuel-air explosive boosted napalm bombs are available, together with SOV-AB persistent toxic chemical agent and NOV-AB non-persistent toxic chemical agent bombs. The precise designations (and hence weights) of these weapons are not known.

Below: An A-7 Corsair of the US Air National Guard displays its load of six 250-kg (550-lb) Snakeye Mk 82 bombs. These are streamlined to prevent drag while being carried, but are fitted with high-drag retarding devices on the tail, which deploy when dropped.

One of the most important types of bomb in the current inventory is the cluster bomb. Consisting of numerous sub-munitions in a single casing, the BL 755 was used extensively by Britain in the Falklands against soft and widely dispersed targets.

Above: The five Belouga BLG 66 dispensers carried by the Mirage 2000 each contain 151 grenades, with either fragmentation, armour-piercing or high-explosive (concussion) effects, depending upon the target to be attacked.

Above: When fitted to aircraft such as the Grumman A-6 Intruder, modern 225-kg (500-lb) or 450-kg (1,000-lb) GP (General Purpose) bombs are often mounted on triple ejector racks, sometimes with two racks to an underwing hard point.

Above: A technique much practiced in Vietnam was the use of lead ships equipped with blind or precision bombing equipment to lead formations of less well-equipped aircraft. The practice continues, with, typically, an F-111 giving release instructions to F-4s.

Below: A US Navy A-7 Corsair being bombed up illustrates both the triple ordnance ejector racks and the high drag tail attachments fitted to standard low drag bombs. On weapon release, the large fins deploy outwards, acting as airbrakes and slowing the bomb.

USA

US guided bombs

One of the major technologies developed for the Vietnam War was laser guidance for iron bombs. Although this was initially a US Air Force project, Texas Instruments helped in the development and ultimately produced the kits for the **Paveway** laser-guided bomb family. This programme has linked more than 30 different systems such as airborne navigation, target marking and identification, and all-weather and night-vision guidance into a single weapon type. The first laser-guided bomb was dropped in trials during 1965, and by 1971 the **Paveway I** family had grown to eight different guidance kits for addition to the nose and and tail of standard free-fall weapons. The guidance and control units were identical for all the kits but the sizes of the canard steering surfaces and tail assemblies varied according to the size of the bomb to be used. The nose-mounted laser seeker is mounted on a two-axis gimbal which has a ring located at its rear. After weapon release, air flowing over the ring causes the seeker to weathercock into the local airstream and hence point approximately towards the target's location. The target itself is illuminated by an airborne or ground-based laser designator, and the seeker on the bomb picks up the laser energy reflected from it, and via the onboard computer commands the control surfaces to guide the bomb towards the reflected energy's source.

The Paveway I family consisted of the **KMU-342/B** kit for the M117 340-kg (750-lb) demolition bomb, the **KMU-351A/B** kit for high- and low-drag versions of the Mk 84 907 kg (2,000-lb) GP bomb, the **KMU-370B/B** for the 1361-kg (3,000-lb) M118E1 demolition bomb, the **KMU-388A/B** for the high- and low-drag versions of the Mk 82 227-kg (500-lb) GP bomb, the **KMU-420/B** for the US Navy's Rockeye Mk 20 Mod 2 227-kg (500-lb) cluster munition which carried 358 0.5-kg (1.1-lb) anti-tank fragmentation bomblets, and the **KMU421/B** for the US Air Force's Pave Storm I 907-kg (2,000-lb) cluster munition based on the SUU-54 dispenser carrying around 1,800 0.5-kg (1.1-lb) anti-tank fragmentation bomblets. The family was subsequently modified to exclude the KMU 342 and KMU 420 kits, whilst the KMU-421/B was switched to the US Navy's and US Marine Corps' Mk 83 454-kg (1,000-lb) GP bomb. Used extensively in the Vietnam War, the family is considered to be of the partial launch-and-leave weapon type as a designator is required, but this is more than offset by their night capability when used in conjunction with a designator fitted with a night sight; this capability extends to poor weather as long as the cloud base is not below 760 m (2,500 ft). The carrying aircraft requires no modification or electrical connection and the bombs are treated and loaded as normal rounds of ammunition.

In 1978 the **Paveway II** family was introduced into service with a new set of components and a folding wing aerofoil group which greatly improves manoeuvrability. The weapons in this series are the **GBU-12D/B** or **GBU-12F/B** (Mk 82 GP bomb), **GBU-16B/B** or **GBU-16C/B** (Mk 83 GP bomb), **GBU-10E/B** or **GBU-10F/B** (Mk 84 GP bomb) for the American services and the **Mk 13/18UK** (454-kg/1,000-lb Mk 13/18 GP bomb) for the Royal Air Force.

Above: The use of precision guidance as applied to unpowered ordnance has led to the distinction between 'smart' weapons and 'iron' or unguided bombs. Paveway, guided by laser, is one of the oldest and most effective systems.

A third generation family, the **Paveway III**, designed specifically for launch at very low altitudes and significant stand-off ranges, has been developed and is to go into production shortly.

At the same time that the original Paveway programme was under way, Rockwell International was designing the **Homing Bomb System** (or **HOBOS**) for the US Air Force as a series of add-on modules to the larger standard bombs, but using initially an electro-optical TV image-contrast tracker and then improved TV and IR guidance seekers for use at night and in poor weather. The kit designations are the **KMU-353A/B** and **KMU-390/B** TV image-contrast systems and the **KMU-359/B** IR system. All three can be fitted to either the Mk 84 GP bomb or the M118E1 demolition bomb, and comprise a guidance section mounted over the bomb's nose, a control module with fins on its rear and four strakes along the body to connect the two assemblies.

To enhance the HOBOS series' capabilities yet further Rockwell looked at a Modular Glide Weapon System. This evolved into the **GBU-15**, which is now in service with the US forces and Israel. The GBU-15 uses a cruciform wing module, a control module, a data-link module, a guidance package and one of two warhead options. The actual configuration chosen depends on the type of target to be attacked, the specific weather conditions and whether the pilot wishes to attack the target directly or indirectly using the data-link pod. The guidance seeker can either be of the electro-optical TV type or of the imaging IR variety. The warhead is either the Mk 84 low-drag GP bomb or the SUU-54 dispenser with 1,800 BLU-63 and/or BLU-86 anti-tank fragmentation bomblets.

The GBU-15, unlike the Paveway system, makes use of an electro-optical guidance system, with either TV or infra-red seekers. At current aircraft attack speeds, release range is some 8 km (5 miles) even at low altitude. When the bomb is lobbed upwards, range is greater.

A powered version of the GBU-15, to be designated **AGM-130**, is currently under development by the firm. This will utilize a rocket booster to triple the maximum low-altitude release range to about 24 km (15 miles) to provide greater aircraft and crew survivability. A capability to carry and dispense boosted kinetic-energy penetrator submunitions is also to be incorporated.

The US Navy is to procure the **AGM-123A Skipper**, which is a Mk 83 bomb equipped with a Paveway II IR seeker and guidance and a Shrike ASM solid-propellant rocket motor. Like the AGM-130, the Skipper is to be used against heavily defended targets to improve the launch platform's safety.

Operators of the Paveway series are Australia, Canada, Greece, the Netherlands, Saudi Arabia, South Korea, Taiwan, Turkey, the UK, US Air Force, US Navy and US Marine Corps, plus others including (it is believed) Israel.

Specification

Paveway I (Mk 82 bomb with KMU-388A/B package)
Type: guided glide bomb
Launch weight: 272.2 kg (600 lb)
Performance: range between 1.5 and 18.3 km (0.93 and 11.4 miles) depending on launch altitude; CEP about 9.1 m (30 ft)
Warhead: HE blast fragmentation

Paveway I (Mk 84 bomb with KMU-351A/B package)
Type: guided glide bomb
Launch weight: 952.6 kg (2,100 lb)
Performance: range between 1.5 and 18.3 km (0.93 and 11.4 miles) depending on launch altitude; CEP about 8.2 m (27 ft)
Warhead: HE blast fragmentation

HOBOS (Mk 84 bomb with KMU-353A/B package)
Type: guided glide bomb
Launch weight: 952.6 kg (2,100 lb)
Performance: range between 1.5 and 24.4 km (0.93 and 15.2 miles) depending on launch altitude; CEP about 6.1 m (20 ft)
Warhead: HE blast fragmentation

GBU-15
Type: guided glide bomb
Launch weight: 1111 kg (2,450 lb)
Performance: range between 1.5 and 82.3 km (0.93 and 51.1 miles) depending on launch altitude and whether or not a data-link pod is used; CEP less than 6.1 m (20 ft)
Warhead: HE blast fragmentation

Guided Bombs in Action

The tremendous technological advances of the 1950s and 1960s in the fields of electronics, computerization and lasers had an enormous effect upon warfare, with weapon guidance especially transformed.

The introduction of the Laser-Guided Bomb (LGB) into the US Air Force weapon inventory during 1968 for use in the Vietnam War brought a new dimension to warfare. It was the first time that the service had available a precision-guided munition (of sufficient weight and with night and poor weather capability) capable of destroying in single hits enemy targets that previously needed large numbers of aircraft with significant payloads of standard iron bombs. During the 'Commando Hunt VII' operations in the Steel Tiger area of Laos in late 1971 and early 1972, the LGBs proved of immense use in the second phase of the aerial interdiction programme, in which they were used at key points to cut roads along which North Vietnamese supply convoys of trucks used to travel. Once the roads were cut, the surrounding area was seeded with ground sensors and air-dropped land mines to form a 'blocking belt': when any of the sensors picked up sounds of the mines being cleared or the belt itself being bypassed, more strike aircraft were vectored in with LGBs or other munitions to attack the enemy force.

In March 1972, when the North Vietnamese regulars operating in support of the Pathet Lao moved against General Van Pao's Meo guerrilla headquarters at Long Thien south of the Plain of Jars, they used a number of the long range M-46 130-mm (5.12-in) artillery pieces to bombard the site. The US Air Force, flying air support for the Meos, found that the guns were difficult to spot and even more difficult to destroy with conventional munitions. Finally several LGBs were used to score direct hits.

The greatest test of the LGBs, especially the Mk 84 907-kg (2,000-lb) variant, came shortly afterwards during the North Vietnamese's Easter 1972 invasion of South Vietnam. This prompted the US government to order its air units to resume the bombing of North Vietnam. One particular target in that country which had been high on the target list since April 1966 (and which had been attacked on a number of occasions by both US Air Force and US Navy aircraft during the various bombing campaigns with hundreds of iron bombs, as well as Bullpup and Walleye guided weapons) was the heavily defended Thanh Hoa rail bridge. This target had cost the Americans a number of aircraft shot down together with aircrew killed, wounded or captured for a relatively poor return in damage inflicted on the structure. However, a single strike by the LGB-equipped McDonnell Douglas F-4 Phantoms of the 8th Tactical Fighter Wing flying from Ubon in Thailand destroyed the bridge, whose spans were dropped during the 6 April-30 June blitz on bridges that saw another 105 bridges also attacked.

Close support

Although extremely useful in such attacks on North Vietnam, the LGB also proved itself in South Vietnam in the tank-busting and close-support roles, where friendly troops had attackers within their positions. The 907-kg (2,000-lb) and 1361-kg (3,000-lb) weapons equipped with laser seekers and carried on such aircraft as the Phantom (supported by a forward air controller in a Rockwell OV-10 Bronco observation plane with a 'Pave Nail' laser designator) proved devastating to North Vietnamese tanks in the area north of Hue, where the open terrain afforded little concealment. On one occasion, for example, a FAC operating at twilight just north of the South Vietnamese marine positions on the My Chanh river line found two armoured vehicles near Route 1: a PT-76 light amphibious tank was trying to extricate a T-53 main battle tank from a dried-up stream bed. Air support was summoned and two Phantoms from Ubon arrived, one with a laser designator system and the other with LGBs. In the space of three minutes the tanks had been illuminated in turn by the designator-carrying aircraft and dispatched with single bombs from the other aircraft.

On 25 April at Fire Base 'Charlie', which had on the previous day been overrun by the North Vietnamese on the way to Kontum, FACs controlled a flight of the Ubon Phantoms to attack enemy troops and vehicles which were trying to take away undamaged South Vietnamese 105-mm (4.13-in) M101 howitzers. Only three Mk 84 LGBs were required to take out three of the guns and five of the trucks that were to be used to move them. Perhaps one of the most telling uses of the LGB occurred in May, after 'Pave Nail'-equipped Broncos arrived in the Highlands to help defend Kontum and its covering fire bases and camps. A Special Forces camp came under intensive North Vietnamese tank and infantry attack, and requested help from an FAC aircraft orbiting overhead; this FAC called up a 'Pave Nail' OV-10 and both arranged to get LGB-equipped F-4D Phantoms from Ubon. The ground contact in the meantime came on to the air and reported that a tank was trying to crush the camp's main command bunker and, overhearing the FAC's conversation, innocently asked what a 'Pave Nail' was. Both FACs told the Special Forces trooper to stand by and they would show him. The OV-10 then illuminated the tank in question with his laser designator and one of the F-4s, which had just arrived, rolled in and released a Mk 84 LGB. The 907-kg (2,000-lb) weapon impacted right beside the tank, the force of the explosion picking the tank up and blowing it back into the camp's perimeter wire. There was then a long silence from the trooper until his voice came on again and said 'What did you call that?' 'Pave Nail,' came the reply, to be answered by 'I need about two more.'

The ability of lasers to pinpoint targets could not be better demonstrated than in the steering of a 900-kg (2,000-lb) bomb through the driver's window of a moving truck. With Paveway about, nobody can afford to relax.

The laser targetting can be carried out either from airborne pods, sometimes carried by the attacking aircraft, or by ground troops acting as forward observers with portable laser equipment.

Laser-guided bombs proved themselves the most accurate of the air-delivered anti-armour weapons, but most of the North Vietnamese tanks destroyed by aircraft were actually hit by standard 227-kg (500-lb) Mk 82 GP bombs delivered mainly by South Vietnamese propeller-driven Douglas A-1 Skyraiders and jet-powered Cessna A-37 light attack aircraft. But although these weapon/aircraft combinations scored the most tank kills, they were not as accurate as LGBs and proved highly vulnerable to ground fire compared with the high-flying LGB-equipped F-4 Phantoms on the same mission.

Guided Bombs in Action

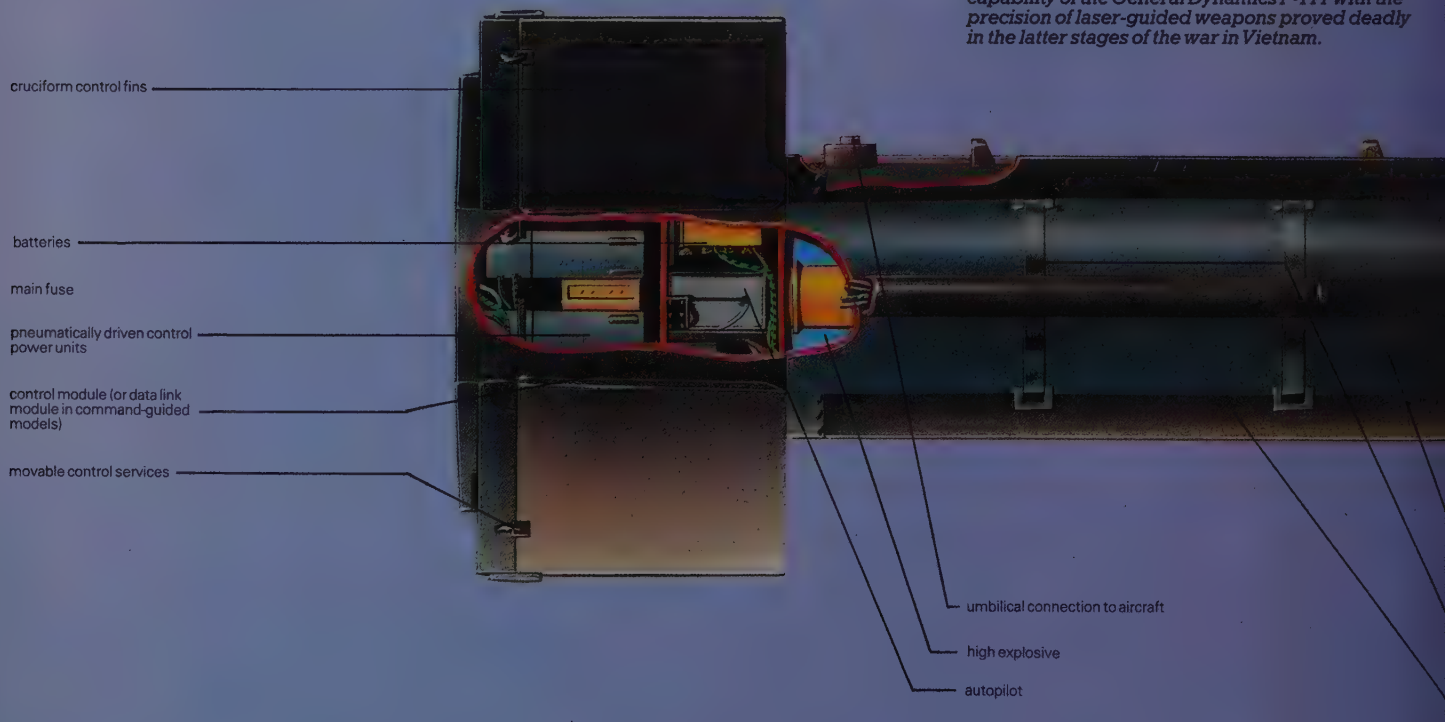
The next recorded combat use of the LGB by a Western nation occurred during the Falklands war of 1982, when the Royal Air Force's BAe Harrier GR.Mk 3s of No. 1 Squadron were taken south for use in the ground-attack role. Standard 454-kg (1,000-lb) medium-capacity HE bombs were converted to the LGB configuration by kits parachuted to the task force from long-range Lockheed C-130 Hercules transports on 27 May. The bombs were released singly in a climb from a pre-computed pull-up point to allow the aircraft to remain clear of any air-defence systems. Only after the bomb had passed the highest point of its trajectory and begun its downward path was the target illuminated by a ground-based Ferranti laser designator. From the Two Sisters position on 13 June, designators were used during individual attacks by two aircraft in the course of the day. In each case the first bomb released apparently missed as a result of the target being illuminated too soon, but in each case the follow-up attack with the second weapon scored direct hits, Squadron-Leader Pooks' attack destroying a 105-mm (4.13-in) M56 pack howitzer position.

More recently the Soviets have begun to use the LGB in Afghanistan as part of an effort to reduce fixed-wing aircraft losses and to assist their ground troops when they are in close-range fire fights with the guerrillas. There is reason to believe that on several recent occasions conventional bombing attacks have caused more losses to the Soviet and government troops than the *mujahadeen* guerrillas.

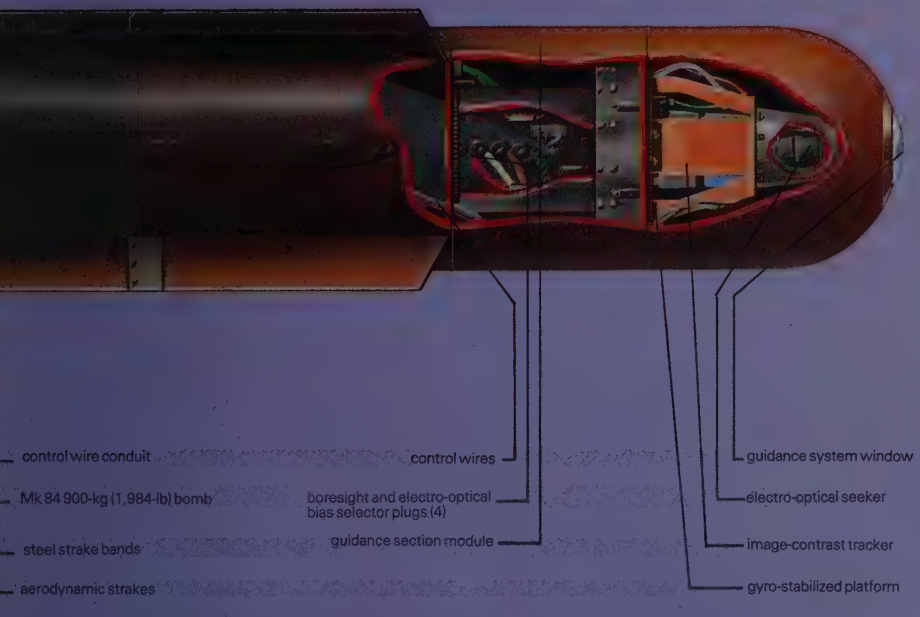
As more countries obtain the LGB, their combat use will become more widespread, and although not yet mentioned in the context of the continuing Iran-Iraq Gulf War, it cannot be long before LGBs are used, if indeed they have not already been employed.

The ordnance to be guided are usually standard weapons, to which have been fitted a seeker head, which senses the laser reflection from a target, a control module, and moveable fins which control the flight.

The combination of the sophisticated all-weather capability of the General Dynamics F-111 with the precision of laser-guided weapons proved deadly in the latter stages of the war in Vietnam.



Laser guidance was extremely useful not only in eliminating difficult targets in North Vietnam but in providing the closest of close support in the south. As long as a designator could be held on a target, then an air strike could be called in; the accuracy of such a strike is shown here against a fast-moving truck. Such pinpoint targetting allowed attacks to be made without fear of hitting friendly forces.



Left: The HOBOS, or homing bomb system, was developed in parallel with the Paveway programme. Usually fitted to standard Mk 84 900 kg (2000-lb) or Mk 118 1360-kg (3,000-lb) bombs and usually carried by McDonnell Douglas F-4 Phantoms in South East Asia, the original EO (Electro-Optical) guided weapon required the WSO (Weapon Systems Officer) to lock the weapon precisely onto target by centring it in the crosshairs on the monitor screen in the cockpit. Securely locked on, the weapon was released and the aircraft then turned away to seek out a new target.

Daring the Dragon's Jaw

One of the hardest nuts to crack during the whole of the conflict in South East Asia, the Thanh Hoa bridge was well named the 'Dragon's Jaw'. Its fall was essential, although many previous attempts had only succeeded in costing valuable lives and aircraft. By 1972, however, the families of 'smart' weapons in service promised more success.

When the North Vietnamese invaded South Vietnam on 30 March 1972, it became painfully obvious that Hanoi had no desire to accept any settlement other than one dictated by a smashing military victory. On 6 April 1972, American aircraft once again were sent north of the DMZ to carry out a co-ordinated interdiction campaign against the North Vietnamese logistic network. Two of the targets were the Thanh Hoa and Paul Doumer bridges. Since the bombing halt in 1968 they had been repaired, and the rail lines crossing the bridges were being fully utilized.

It was clear to the targeteers, mission planners, and strike pilots that destroying the Thanh Hoa and Doumer bridges would not be a simple task. They had taken their toll of US aircraft and pilots during the early years of the war, and there was no reason to suspect that the defences around them had been softened. There was, however, a glimmer of hope echoing along the halls and in the briefing rooms of the fighter squadrons because some new weapons were now available for such a mission.

A new family of 'smart bombs' had been introduced in South East Asia since the bombing halt in 1968. These weapons consisted of Electro-Optical guided Bombs (EOGBs) and Laser Guided bombs (LGBs) in the 907-kg (2,000-lb) and 1361-kg (3,000-lb) class. The EOGB was a contrast weapon, similar in concept to the Walleye first used in 1967 by the US Navy. The EOGB, however, was a 907-kg bomb with a small TV camera attached to the nose which transmitted a picture of what it was viewing to a scope in the attack aircraft. The pilot would point the aircraft and weapon at the target area, thereby allowing the Weapon Systems Operator (WSO) in the rear cockpit of the McDonnell Douglas F-4 Phantom to find the target on the scope, refine the contrast aiming point and designate the target to the weapon. Once this was accomplished, the pilot would release the bomb and quickly depart the target area, leaving the EOGB to guide itself toward the designated aim point. Target weather and cloud cover was a factor when delivering EOGBs, but if the weapon could see the target when it was released from the aircraft it would usually impact the aim point.

The LGB was somewhat different. A laser sensor was mated to the nose of a 907-kg or 1361-kg bomb which enabled it to guide itself toward a target illuminated with low power laser energy. The problem of illuminating the target with this laser energy was solved by attaching a pod beneath the fighter aircraft. This pod contained an optical viewing system and laser emitting capability, both operated by the WSO in the back seat of the fighter. With this system, the pilot could point his aircraft toward the target while his WSO optically located the precise target aim point and illuminated it with his laser equipment. The pilot would then release his bombs and depart the target area, leaving the LGB to guide itself to the target, which was kept under laser illumination by a swivelling pod or by another aircraft with a laser target designator. An advantage of this system was that more than one aircraft at a time could drop LGBs on the same target, with all weapons using the same illumination point to guide on. Both the EOGB and the LGB resulted in less aircrew exposure and greater accuracy than conventional weapons. A disadvantage was that the target had to be continuously illuminated by the laser for the LGB to be effective. If clouds obstructed the view of the illuminating pod the LGB would become an unguided bomb and probably miss the target.

The new EOGBs and LGBs were given to the 8th Tactical Fighter Wing (TFW) operating F-4 Phantoms from Ubon Royal Thai Air Base, Thailand. The 8th TFW was known as the 'Wolfpack MiG Killers' – a name acquired for their effectiveness in destroying more MiG aircraft during Rolling Thunder than any other US tactical fighter wing operating in North Vietnam. The wing, commanded at this time by Colonel (now Brigadier General) Carl S. Miller, was soon to earn the title of 'Bridge Busters' as a consequence of the wing's use of the new weapons against the North Vietnamese supply system. Between 6 April 1972 and 30 June 1972, the 8th TFW F-4 aircraft were to destroy a total of 106 bridges, including the Paul Doumer and the Thanh Hoa, with the new guided bombs.

In addition to the guided bombs, US air power had increased its capabilities by improving its electronic countermeasures (ECM) through the use of 'chaff' dropped from F-4 aircraft.

Operation 'Freedom Dawn'

With the authorization to re-initiate the bombing of North Vietnam, several air operations plans were drawn up to satisfy the interdiction requirements directed by the upper echelon planners. One of these plans, 'Freedom Dawn', included, among other targets, the Thanh Hoa bridge. The plan called for a small tactical strike force to destroy the Dragon's Jaw with the new family of guided bombs.

The operation was to be carried out by 12 F-4 Phantoms from the 8th TFW, eight of them loaded with 907-kg guided weapons. A flight of four Phantoms was to lay a chaff corridor from the initial point to the target so that the eight bomb-laden F-4s could operate in a relatively sterilized radar environment. Bad weather in the target area had been the cause of several last-minute postponements of the mission, but on 27 April 1972 reports indicated the weather had cleared sufficiently over Thanh Hoa to permit the strike.

On that day, the 12 Phantoms took off from Ubon, and the three flights of four aircraft each headed for an air refuelling area where SAC KC-135 tankers were orbiting, waiting to offload extra fuel to the fighters. This fuel might be necessary should enemy fighters appear or should the RESCAP of a downed aircrew become a reality. Having some extra JP4 fuel might mean the difference between making one last turn to destroy an enemy MiG or being able to orbit a downed crewman and provide suppressive fire against ground forces until SAR aircraft arrived.

With several thousand kilograms of fuel obtained from the tankers, the fighters headed for the bridge. The chaff delivery aircraft had gone out in front to form the protective corridor in advance of the strike aircraft. However, as the strike aircraft approached the IP, a glance in the direction of the target revealed heavy cloud cover which could hamper the use of the guided bombs. The heavy cloud cover and poor visibility precluded the use of LGB illuminators to designate the target continuously, making it a day for the EOGB weapons. The aircraft carrying the EOGBs then positioned themselves for the strike, and let loose their weapons. The extremely heavy anti-aircraft fire filled the skies with hundreds of white, grey and black puffs of smoke from exploding AAA shells. A number of SA-2 SAMs were fired at the aircraft, but SAM effectiveness was reduced by the chaff – so much so that the Phantoms escaped without a scratch. Post-mission photo reconnaissance showed the damage to the bridge to be extensive enough to render it unusable to vehicle traffic. The EOGBs had severely shaken the structure, but stubborn to the end, the Dragon's Jaw would need one more punch.

'Linebacker I'

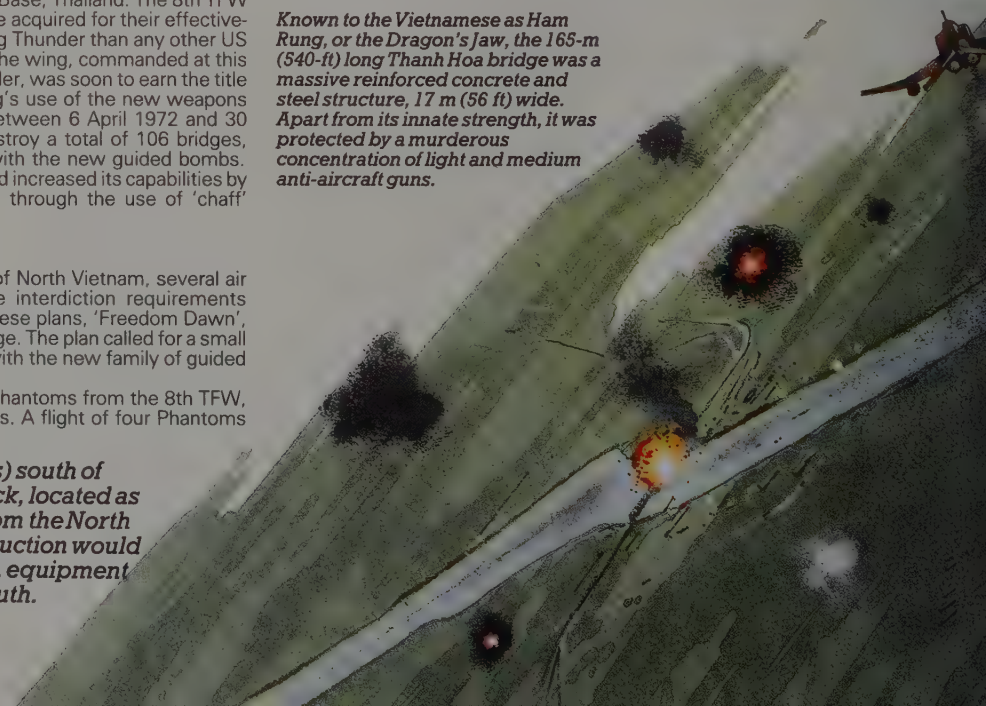
On 10 May, Operation 'Linebacker I', the start of the increased interdiction effort in the north was initiated. Heavy air strikes were flown against targets in the Hanoi-Haiphong area and reduced to rubble many key objectives previously 'off limits'.

After three days of 'Linebacker' activity, the Thanh Hoa bridge was once again highlighted on the daily mission orders, which was to be similar to that flown on 27 April except that the weather was forecast to be better and two additional aircraft were scheduled, making a total of 14 strike aircraft. Guided bombs were on the agenda again; however, this time, nine 1361-kg LGBs would be used in conjunction with 15 907-kg LGBs and 48 227-kg (500-lb) conventional bombs.

On the morning of 13 May, the attacking force members annotated their maps with updated SAM plots and received final briefings on enemy AAA defences, air refuelling tracks, positions of supporting ECM forces and the SAR procedures. The target weather was briefed as good. The strike group took off on schedule and rendezvoused with the KC-135 tankers for the pre-strike refuelling.

The pilots then set an easterly course across southern North Vietnam to the Gulf of Tonkin, and from there north to the target area. Approaching the target, everyone could see that the weather forecaster had been correct. No trouble – some clouds were evident and the flights positioned for the attack.

With the target in sight, the lead aircraft rolled in for the kill, unleashing his LGBs at the bridge. Plane after plane followed, with each pilot hoping that the anti-aircraft flashes on the ground did not signal a shot destined for his aircraft. As they dropped more bombs on the target, the last few pilots saw large clouds of dust and belches of fire as the bombs exploded on the bridge. After the final



Known to the Vietnamese as Ham Rung, or the Dragon's Jaw, the 165-m (540-ft) long Thanh Hoa bridge was a massive reinforced concrete and steel structure, 17 m (56 ft) wide. Apart from its innate strength, it was protected by a murderous concentration of light and medium anti-aircraft guns.

The Thanh Hoa bridge, 112 km (70 miles) south of Hanoi, was a major target for US air attack, located as it was on the main road and rail route from the North into Laos and to South Vietnam. Its destruction would seriously hamper the movement of men, equipment and supplies to the battlefields of the South.

aircraft had pulled away from the target, the strike pilots knew the bridge was down and headed for home – misson accomplished.

No aircraft had been damaged, even though the AAA and SAM fire had been intense. Post-strike photography by RF-4Cs confirmed the strike pilots' assessment. The western span of the bridge had been knocked completely off its 12-m (40 ft) thick concrete abutment and the bridge superstructure was so critically disfigured and twisted that rail traffic would come to a standstill for at least several months.

The interdiction campaign against North Vietnam grew in intensity during May 1972, and the enemy LOCs showed signs of crumbling under the continuous assault by American air power. Guided bombs were used with increasing regularity and success.

By the end of May 1972, there were 13 important rail bridges down along the two major rail lines running north east and north west from Hanoi. There were another four rail bridges down between Hanoi and Haiphong, and several more had been dropped on the rail line running south from Hanoi.

The Dragon is down

Although the bridge had been severely damaged on the 13 May strike, the ambitious North Vietnamese immediately began to repair its structure so that rail traffic could again cross the Song Ma River. As a result, it was necessary to schedule strikes periodically to hinder the repair efforts. The navy flew 11 more missions against the Thanh Hoa bridge and the US Air Force two more missions before 23 October 1972, the day President Nixon stopped all bombing of North Vietnam. With this bombing halt, the saga of the 'Dragon's Jaw' came to a close. Although bombing would be seen over North Vietnam again during 'Linebacker II' in December 1972, the Thanh Hoa bridge was not on the target list during the campaign, for it was still in a state of disrepair.

The McDonnell Douglas F-4 Phantom was the most versatile tactical aircraft used by the USAF in South East Asia. It equipped the 8th TFW, based at Ubon in Thailand. Known as the 'Wolfpack MiG Killers', their possession of the F-4 together with the new guided bombs was to give them a new nickname in the spring of 1972: they had become the 'Bridge Busters'.

Early strikes against the bridge had shown that bombs of less than 450 kg (1,000 lb) did little more than tickle the massively constructed bridge. For the 1972 strikes, the guided bombs were all in the 900 to 1360 kg (2,000 to 3,000 lb) class. The attacks of 27 April and 13 May were to be the knockout punch to the Dragon's Jaw.

UK/WEST GERMANY

Hunting Engineering JP233 and Raketen-Technik GmbH (RTG) Mehrzweckwaffe-1 (MW-1) dispenser weapons

To arm their Panavia Tornado strike and interdiction aircraft, the British and West Germans independently designed and built large container dispenser weapons for installation beneath the fuselage. The **Hunting JP233**, although originally a joint venture with the Americans, will be primarily used by the Royal Air Force in counter-air operations to close Warsaw Pact airfields whilst retaining the capability to be used against other types of targets where large-scale disruption of military movements is required. To accomplish these objectives two types of submunitions are dispensed: that designated SG357 is designed to damage and render inoperative such facilities as concrete runways, taxiways and grass operating strips, whilst the HB876 area-denial submunition is designed as a continuous threat to vehicles or personnel trying to repair the crater damage caused by the SG357. To ensure an effective coverage of the target area, both types are dispensed simultaneously in a co-ordinated sequence of 30 SG357s and 215 HB876s. Each Royal Air Force Tornado will carry two of the JP233 pods, and the dispenser can also be configured for carriage by aircraft such as the General Dynamics F-16 Fighting Falcon.

In contrast with the British approach, the West Germans have developed the **RTG MW-1** multi-purpose dispenser for use against airfields and massed armoured units on the move. The submunitions carried are thus divided into two main-target groups that can be preset just before firing to be scattered over an area about 500 m (1,640 ft) wide and up to 4000 m (13,125 ft) long depending upon the target's nature and concentration. For the anti-armour mission the MW-1 carries Group 1 which comprises 672 MIFF anti-armour mines (each with two back-to-back HEAT warheads), or 4,500 KB44 anti-armour/anti-personnel shaped-charge fragmentation bomblets, or a combination of the two. This version has already entered Luftwaffe service, whereas Group 2 for anti-airfield use will not be in service until 1987. This group comprises either a single load of 224 STABO braked dual-warhead cratering munitions or various combinations of 672 MIFF mines, MUSA delayed-action fragmentation minelets and MUSPA acoustically-activated area-denial mines. This means that to close a runway effectively several Luftwaffe Tornados will have to overfly the runway to cut it with STABO-filled MW-1s whilst others sow the surrounding areas with the mixed loads of area-denial submunitions. The Italian air force has also ordered the anti-runway MW-1 in a modified form carrying only a STABO payload.

A Tornado disgorges a shower of submunitions from its JP233 dispensers. Conventional bombs can crater a runway, but holes can quickly be filled; the 30 SG357 bomblets in the JP233 penetrate and fracture a huge area of the concrete surface.

Left: As with most of the modern family of dispenser weapons, the MW-1 can carry a wide variety of submunitions, including anti-armour mines for dealing with tank formations or cratering weapons to render enemy airfields unusable.

Above: The JP233 is more specifically designed for the airfield denial role, with its cratering submunitions being seconded by anti-vehicle and anti-personnel weapons designed to hamper any runway repair efforts.

UK

British Aerospace Dynamics Group/Marconi Space and Defence Systems Air-Launched Anti-Radar Missile (ALARM)

Left: Similar to Sky Flash in size, the ALARM missile has been chosen to provide the Royal Air Force with state-of-the-art defence suppression.

The **BAe/MSDS ALARM** was developed to meet the early 1980s requirement of Air Staff Target (AST) 1228, and was in direct competition with the American AGM-88 HARM for a total Royal Air Force buy of around 2,000 rounds. In July 1983 it was announced that the ALARM was the chosen missile, with the first production rounds to enter service in 1987. The design rationale of ALARM is that it is an autonomous system light enough for several to be carried on a strike aircraft in addition to its normal interdiction payload. The weight is thought to be around 175 kg (385 lb), and the weapon can be fitted to fixed-wing aircraft down to the size of the BAe Hawk as well as to larger machines such as the Panavia Tornado; the missile can also be installed on helicopters.

No reliable specifications of the missile have yet been released, but the configuration appears to follow that of the Sky Flash AAM though with a larger body allied to smaller wings and control surfaces. Two modes of operation will apparently be used: the self-defence mode, whereby the sophisticated Marconi broad-band seeker locks onto an emitting radar whilst the missile is still on the carrier; and the defence-suppression parachute mode, whereby the missile is fired as the aircraft approaches the target. The ALARM then zooms up under powered flight to a height of around 12190 m (40,000 ft), where it cuts its motor and pitches over to point downwards at the end of a drogue parachute deployed after the motor is cut. The seeker then begins a search for radar emitters, from which the most important signal is identified, and then commands the missile to discard the parachute and relight the rocket motor so the missile can attack the chosen source. At present the Royal Air Force uses limited stocks of the American AGM-45 Shrike and the AS.37 ARM version of the Anglo-French Martel ASM for the defence-suppression task.

The sophisticated electronics and guidance planned for ALARM promise an extremely capable missile that can deal with a wide range of targets. Nevertheless, it is still in the early stages of development.

USA

Texas Instruments AGM-45 Shrike and General Dynamics AGM-78 Standard ARM

Based upon the AIM-7 Sparrow AAM airframe, the Texas Instruments Shrike has a larger warhead and less powerful rocket motor. Although used extensively, the performance is less than satisfactory.

Specialized anti-radar missiles (ARMs) were developed by the US Navy from 1958 onwards as a means of improving the survivability of conventional attack aircraft, either by deterring the enemy from operating his defensive radar or by directly destroying the radar's antenna. The first tactical ARM to enter production was the **Texas Instruments AGM-45A Shrike** in 1963. This was essentially a Sparrow AAM airframe with an enlarged blast-fragmentation warhead and a smaller rocket motor. Although used extensively by the US forces in Vietnam, by Israel against the Arabs and by the UK in the 1982 Falklands war, the Shrike has displayed a not altogether satisfactory performance as a result of design limitations associated primarily with the seeker. There are no memory circuits available, and this means that the shutdown of the radar being attacked causes the missile to go ballistic. The seeker is also rigidly mounted, so the missile must be pointed towards the target at launch, and the seeker has to be tuned before take-off to the wavelength band of the radar system under attack, otherwise it cannot pick up any emissions. A total of 13 different seekers to cover likely target systems has thus been developed. Total production for the USAF and US Navy was about 18,500 rounds, the larger number going to the former service, which uses it primarily on the McDonnell Douglas F-4G Phantom 'Wild Weasel II' defence-suppression aircraft together with the **General Dynamics AGM-78 Standard ARM**.

The latter missile was contracted in 1966 because the Shrike's combat performance was found to be bad. Designated **AGM-78A Standard** in its initial form, it was based on the Standard shipboard SAM and initially equipped with the Shrike seeker with all its faults. Production soon shifted to the **AGM-78B** version with a gimballed wide-band seeker and a memory circuit that required no pretuning, thus permitting an attack even if the radar had ceased emitting signals. An **AGM-78C** variant was then produced for the US Air Force, the subsequent **AGM-78D** and **AGM-78D2** models further increasing the seeker capabilities. Over 3,000 rounds had been built by the time the last delivery of a batch of AGM-78D2 missiles was made in August 1976. Ultimately both the Shrike and Standard will be replaced by the AGM-88A HARM, and current operators of the type are Israel (not certainly), South Korea, the US Air Force, US Marine Corps and US Navy. The Shrike is in slightly more widespread service, current operators including Iran, Israel, the UK, US Air Force, US Marine Corps and US Navy.

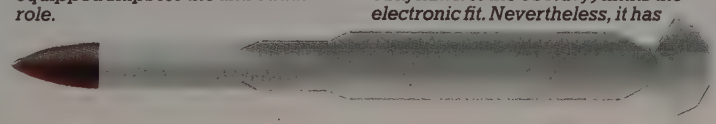
Specification
AGM-45 Shrike
Type: anti-radiation air-to-surface missile
Dimensions: length 3.048 m (10 ft 0 in); span 0.914 m (3 ft 0 in); diameter 0.203 m (8 in)
Launch weight: 176.9 kg (390 lb)
Propulsion: solid-propellant rocket motor
Performance: speed Mach 2; range 46.5 km (28.9 miles); CEP reasonable if the target radar continues to emit
Guidance: passive radar-homing
Warhead: 65.8-kg (145-lb) HE blast fragmentation

Specification
AGM-78 Standard ARM
Type: anti-radiation air-to-surface missile
Dimensions: length 4.572 m (15 ft 0 in); span 1.092 m (3 ft 7 in); diameter 0.343 m (13.5 in)
Launch weight: 615.1 kg (1,356 lb)
Propulsion: solid-propellant rocket motor
Performance: speed Mach 2.5; range 112.65+ km (70+ miles); CEP good even if the target radar ceases transmitting
Guidance: passive radar-homing
Warhead: 97.4-kg (214.7-lb) HE blast fragmentation

Above: The much larger and more capable Standard ARM (foreground) is replacing the Shrike (background) in US service. Developed from the Standard naval SAM, the ARM has a memory circuit which enables it to attack a radar site even when it has stopped transmitting.

Above: The small size of the Shrike (seen here mounted on a Douglas A-4 Skyhawk of the US Navy) limits the electronic fit. Nevertheless, it has been used to great effect by Israel to deal with Syrian missile sites in the Lebanon.

Below: Developed from a naval area defence missile, the Standard ARM has the excellent range of over 112 km (70 miles). The missile is also available to be fired from Standard-equipped ships for the anti-radar role.



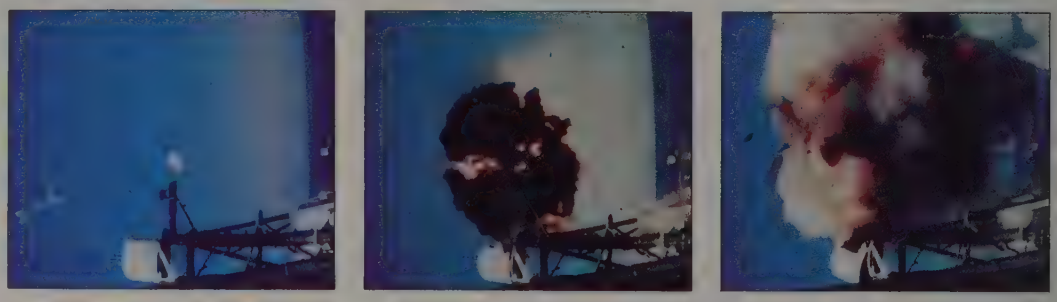
USA

Texas Instruments AGM-88A High-speed Anti-Radiation Missile (HARM)

Similar in appearance to the Shrike missile it will replace, HARM (High-speed Anti-Radiation Missile) is a larger weapon with a greatly improved performance. It will also replace the Standard ARM, having similar performance with much improved electronics.

Although the Standard ARM was an improvement on the Shrike, its combat performance in Vietnam was still not very inspiring as its memory circuits proved less than satisfactory. Also the Standard was five times costlier and three times heavier than the Shrike, so a requirement for a new ARM was established. The result was the **Texas Instruments AGM-88A HARM**, which emphasizes high speed so that any defending radar operator has only minimum warning times to 'shut down' his system; this attacker's advantage is multiplied by the fact that the launch platform does not need to execute any characteristic launch manoeuvre.

Initial development of the HARM began in late 1969 by the US Navy, but progress was halted by severe technical problems which were not resolved until 1973. Further delays were then experienced with the Texas Instruments guidance seeker and initial production deliveries were not made until 1983. The missile has three modes of operation: the self-protection mode, in which a threat receiver on the launch platform detects a radar signal and programmes the missiles seeker before it is fired; the 'target-of-opportunity' mode, in which the sensitive seeker on the missile itself locks on to an emitting radar; and the 'pre-briefed' mode, in which the missile is fired blind in the general direction of a possible target with its seeker searching for a signal onto which the missile can home. In the last mode, failure to detect a signal initiates a programme for self-destruction. Like its two predecessors, the HARM can also be fired in a 'loft' manoeuvre to increase its range, the target being acquired on the downward portion of the trajectory. The warhead is detonated at a preset height over the target by a laser proximity fuse in order to maximize damage to the antenna and electronics.



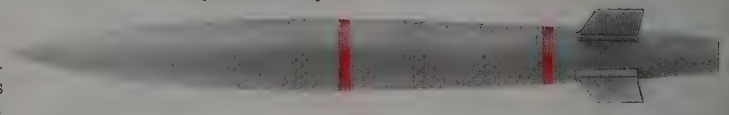
Travelling at more than 3200 km/h (2,000 mph), this sequence of HARM in its final approach would take a split second. Designed to use its very high speed to give the opposing radar operator as little time as possible to switch off when detected, HARM destroys its targets by means of a 66-kg (145-lb) high-explosive blast warhead.

Carried on a McDonnell Douglas F-4G Phantom, HARM missiles are just entering US service. Initial requirement was for almost 700 missiles, at a unit cost of nearly a million dollars per missile, with even larger numbers to be procured in the years to come.

Specification
AGM-88A
Type: anti-radiation air-to-surface missile
Dimensions: length 4.171 m (13 ft 8.2 in); span 1.118 m (3 ft 8 in); diameter 0.254 m (10 in)
Launch weight: 361.1 kg (796 lb)
Propulsion: solid-propellant rocket
Performance: speed Mach 3+; range 74.4+ km (46.25+ miles); CEP very good
Guidance: passive radar-homing
Warhead: 65.8-kg (145-lb) HE blast fragmentation

USA

Boeing AGM-69A Short-Range Attack Missile (SRAM)



Equipping Strategic Air Command's bomber force, the AGM-69A SRAM (Short Range Attack Missile) is mainly designed for interdiction duties deep behind enemy lines.

In 1964 the US Air Force began development of the **Boeing AGM-69A SRAM**, for use primarily against major defensive installations deep within enemy territory whilst the launch platform remains outside the enemy's engagement zone. The missile was also required to attack main-mission targets as well if they were suitable or if they had exceptionally heavy anti-aircraft defences. The first production round was delivered to the Strategic Air Command in 1972, the last of 1,500 being delivered three years later. Some 1,150 SRAMs currently remain in the operational inventory. The major carrier of the type is the Boeing Stratofortress, the B-52G and B-52H models each being able to carry 20 missiles. The more usual load is six or eight SRAMs as well as four free-fall thermonuclear gravity bombs. The General Dynamics FB-111A can carry up to six SRAMs, but those aircraft which do carry them as part of their normal weapons load only have just two.

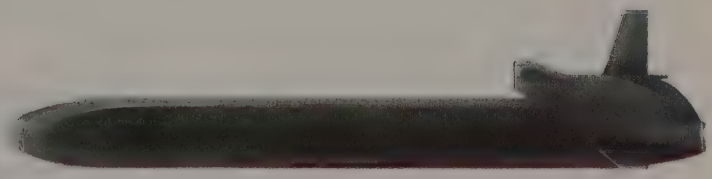
Four basic flight profiles can be utilized in an attack: semi-ballistic from the point of launch to the target; altimeter-controlled terrain-following; ballistic pull-up from behind screening terrain using inertially-guided flight for the terminal phase; and a combination of inertial and terrain-following. Each profile can further be enhanced by the programming into the missile's onboard guidance system of deviations in direction of up to 180°. The range depends entirely upon what launch altitude and flight profile is chosen. Once over the target the warhead can either detonate on contact to give a ground burst or at a preset altitude to give an air burst nuclear explosion, the type of explosion being chosen according to the target type and the damage level required. The missile's computer can be retargeted at any time up to launch. The SRAM is expected to stay in service for a number of years to come.

Specification
AGM-69A
Type: short-range air-to-surface strategic missile
Dimensions: length 4.267 m (14 ft 0 in) fo internal carriage or 4.826 m (15 ft 10 in) for external carriage; span 0.762 m (2 ft 6 in); diameter 0.445 m (17.5 in)
Launch weight: 1016 kg (2,240 lb)
Propulsion: two solid-propellant rocket motors
Performance: speed Mach 3.5; range between 56.3 and 80.5 km (35 and 50 miles) at low altitude, or between 160.9 and 221.3 km (100 and 137.5 miles) at high altitude; CEP 457 m (500 yards)
Guidance: inertial
Warhead: W69 170-kiloton yield nuclear

SRAM is carried by Boeing B-52G bombers and by the FB-111 of SAC. The SRAM's Mach 3.5 speed and low-level range of up to 80 km (50 miles) allow bombers to make stand off attacks.

USA

Boeing AGM-86 Air-Launched Cruise Missile (ALCM)



With a range in excess of 3000 km (1,850 miles), the AGM-68B gives the USAF a weapon which will enable its bombers to make strategic attacks without having to face the task of trying to penetrate modern defences.

The **Boeing ALCM** is the result of a US Air Force requirement to provide an air-launched strategic weapon for deployment on the Boeing B-52 bomber and successor designs.

The original **AGM-86A** was to be interchangeable with the AGM-69A SRAM on the latter's internal B-52 eight-round rotary launcher. However, because the weapon was considered to be short on range, and because of a Department of Defense's 1979 decision to hold a fly-off between the AGM-86A and the General Dynamics AGM-109 Tomahawk cruise missile, a considerably stretched version, the **AGM-86B**, was produced. This was some 30 per cent longer and effectively doubled the missile's range for a given warhead.

In 1980, following a considerable delay in announcing the results, the US Air Force revealed that the AGM-86B was the chosen weapon. The first two rounds were delivered to the Strategic Air Command in 1981. The B-52G is being modified to carry 12 AGM-86B missiles on two underwing pylons whilst retaining its internal load of SRAMs and free-fall nuclear bombs. The more modern B-52H will have the same external pylon load, but the bomb bay of each aircraft is to be rebuilt to accommodate an additional eight ALCMs on a new rotary launcher. The follow-on Rockwell B-1B will be able to contain the same internal rotary launcher and up to 14 more ALCMs will be carried on external racks. A total of 4,348 ALCMs is planned before production switches to the Advanced Cruise Missile design.

B-52H aircraft are being modified to accept a rotary ALCM launcher in their bomb bays. Cruise missile carriers are to be fitted with special leading edge extensions, in accordance with the SALT treaties, to enable identification by surveillance satellites.

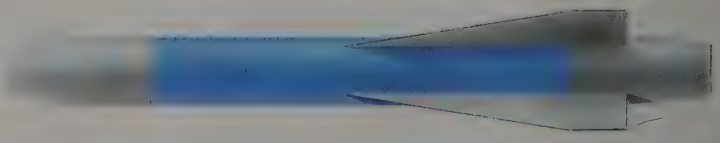
Specification
AGM-86B
Type: air-launched strategic cruise missile
Dimensions: length 6.325 m (20 ft 9 in); span 3.658 m (12 ft 0 in); diameter 0.693 m (27.3 in)
Launch weight: 1281.4 kg (2,825 lb)
Propulsion: one turbofan
Performance: speed 805 km/h. (500 mph); range 3138 km (1,950 miles); CEP between 10 and 30 m (32.8 and 98.4 ft)
Guidance: inertial with terrain contour updating
Warhead: W80-1 200-kiloton yield nuclear

Major carrier of ALCMs will be the Rockwell B-1B bomber. Until it enters service, the trusty old B-52 (some of which are older than their pilots!) will remain the primary delivery system. The B-1B will carry 8 missiles internally and 26 on underwing pylons.

USA

Hughes/Martin AGM-62 Walleye

Right: Television guided, the Walleye is a 3.54 m (11 ft 4 in) glide bomb with a 375 kg (825-lb) shaped charge warhead in its original form. Later models have a much greater warload.



Developed from 1963 onwards by the US Naval Weapons Center at China Lake, with first production deliveries by Hughes in 1966 and by second-source contractor Martin Marietta in 1967, the **Hughes/Martin AGM-62 Walleye** family of TV-guided unpowered glide bombs entered into the US Navy's weapon inventory in the latter year. The first version was the **AGM-62A Walleye I**, of which 4,531 were produced. This could be carried at speeds up to Mach 1.9 and be launched from altitudes up to 10670 m (35,000 ft). It was used extensively in the Vietnam War, 920 being used in the 1972 'Linebacker II' missions alone. Its targets were mainly large buildings with interior contrast windows and various types of bridges. Against the 'soft' wooden bridge structures the results were excellent, but when a 'hard' bridge (requiring a span to be destroyed) was attacked the result was usually only bent girders. As the warhead was not large enough to attack such 'hard' targets, Martin Marietta converted 1,481 of the Walleye Is and built 529 new missiles to the longer-range **Walleye II** configuration, with a warhead over twice the original size and a new seeker with a smaller 'gate' for slightly greater accuracy. The Walleye guidance system allows the pilot to lock-on before launch, launch the weapon and then exit the area. The only requirement is that the selected target must contrast sharply (in visual terms) with its surroundings so that the gyro-stabilized TV camera in the Walleye's nose can be 'gated' before launch to remain pointing at the area of high contrast and thus guide the missile in flight. As it closes the target the Walleye II gains accuracy since the image it sees is expanded in the TV system's field of view.

To extend the range of the missile still farther, a lock-on-after-launch variant was introduced. This required a two-way data-link so that the pilot in the retiring aircraft could see the TV picture in order to select a target and command the lock-on. The result was the **Extended-Range Data-Link (ERDL) Walleye**, which entered initial production in 1972. A total of 1,400 Walleye I and 2,400 Walleye II rounds have been converted to this configuration. The US Navy prefers to use a two-aircraft formation with this weapon, one to carry and launch the missile, and the other to order lock-on or guide it manually all the way to the target using the data-link pod. Three ERDL Walleye IIs were combat-tested against targets invisible to the pilot at the time of launch during the 1972 bombing of North Vietnam, and all three scored direct hits. A nuclear version of the Walleye I, with the 100-kiloton yield W72 warhead, was also operated by the US Navy between 1970 and 1979. Against tank-sized targets the maximum range of most of the USA's guided weapons is 4.8 km (3 miles). The Walleye is also used by Israel.

Walleye II is seen aboard an US Navy Corsair. Most recent development of Walleye has centred around the ER/DL modification; larger wings extend the glide range and enhanced electronics allow the missile to be released before lock-on, subsequent guidance being provided by a data link.

Specification
Walleye series
Type: guided glide bomb
Dimensions: length (Walleye I) 3.454 m (11 ft 4 in) and (Walleye II) 4.039 m (13 ft 3 in); span (Walleye I) 1.156 m (3 ft 9.5 in) and (Walleye II) 1.295 m (4 ft 3 in); diameter (Walleye I) 0.318 m (12.5 in) and (Walleye II) 0.457 m (18 in)
Launch weight: (Walleye I) 512.6 kg (1,130 lb) and (Walleye II) 1061.4 kg (2,340 lb)
Performance: range (Walleye I) between 1.8 and 29.6 km (1.12 and 18.4 miles) and (Walleye II) between 1.8 and 45 km (1.12 and 28 miles), while ERDL versions have a maximum range extended by at least 30 per cent; CEP between 4.6 and 6.1 m (15 and 20 ft)
Warhead: (Walleye I) 374.2-kg (825-lb) HE linear shaped charge, and (Walleye II) 861.8-kg (1,900-lb) HE linear shaped charge

Area Denial Weapons

While battle across the Central Front in Europe remains an unlikely prospect, military planners nevertheless have to respond to a potential threat. Given the current Soviet numerical superiority in conventional terms, NATO has to consider methods of dealing with multiple targets with one shot.

Designed specifically to prevent passage of enemy troops and vehicles, the area-denial weapon usually consists of a dispenser with a number of submunitions in the form of bomblets or mines fitted with one or more type of fuse. These last may be of the delayed-action type, whereby the submunition becomes live only after a preset time period has passed; or of the permanent fuse type, whereby the device is live from the moment of laying and remains so until it is detonated by an external source; or of the self-destruct type, whereby the weapon is live when laid but after a preprogrammed time renders itself somehow inoperative, or more simply explodes.

The US armed forces, using the experience of the Vietnam War as their guideline, were especially gifted in developing munitions of this type. The US Air Force's latest example is the current Gator anti-armour mine system. Designed for laying from high-speed aircraft of all the services for interdiction of second-echelon forces in assembly areas and on the march, the Gator has as submunitions the Honeywell BLU-91/B magnetic influence anti-tank mine and the Aerojet BLU-92/B anti-personnel fragmentation mine. Each mine has three selectable self-destruct times, the chosen period being set on the dispenser before the mission. A total of six Cluster Bomb Units (CBUs) have been identified with the system: the CBU-78/B and CBU-84/B each carry both types of mine, the CBU-82/B and the CBU-85/B carry the BLU-91/B, and the CBU-83/B and CBU-86/B carry the BLU-92/B.

In European circles the British have not had the same inclination to follow this path, but instead have evolved the Hunting Engineering JP233, which will be used with a cratering submunition and an area-denial weapon to prevent repairs to the area damaged by the cratering device.

The West Germans have taken this concept further with their MW-1 multi-purpose dispenser, for which they have produced a whole range of predominantly area-denial type submunitions. These are subdivided into two mixes for use against specific classes of targets.

Surprisingly Israel, which has had more combat experience than most against the whole spectrum of targets likely to be encountered during air-to-surface operations in any future war, has not been seen to use area-denial weapons of the types described above. It prefers instead to rely on more conventional iron bombs with simple delay-action fuses and on instantaneous effect CBUs such as the TAL-1 and TAL-2.

The Soviets have in contrast used a number of area-denial weapons during the Afghanistan war, where for example helicopters and fixed-wing aircraft have dropped canisters that dispense in flight large numbers of small irregularly-shaped plastic PFM-1 minelets filled with sufficient liquid explosive to blow off a person's hand or foot. This is a particularly effective weapon against the *mujahadeen* guerrillas, who have to walk and to use animals to carry their weapons and supplies. In the same category must be placed the persistent chemical agent-filled iron bomb and shell, which significantly restrict or totally prevent movement by unprotected personnel and equipment over any section of terrain contaminated with an agent that is lethal to humans by skin absorption or inhalation. The Soviets have used such bombs in Afghanistan, and the Iraqis have used similar munitions against the Iranians in recent months.

A slightly different situation is covered by the very large mine-dispensing systems used by helicopters. These are typified by the Valsella VS/MD scatter-dropping unit for carriage as an underslung load by medium- or heavy-lift helicopters. This system usually carries a mix of VS-1.6 anti-armour and VS-50 or VS- Mk 2 anti-personnel mines, which are laid as part of a large 'quick' reaction minefield during rapidly changing tactical situations such as an enemy breakthrough. This particular field is well covered by the Italians, although West Germany and the UK are now exploring the possibilities.

For the future the adaptation of 'smart' submunitions to area-denial technology is obvious, a case in point being the development of the Extended-Range Anti-armour Munition (ERAM) for use in the US Air Force's Tactical Munition Dispenser, the SUU-65/B, to form the CBU-92/B munition. The ERAM is ejected randomly over the target area and floats down on a parachute. Once on the ground, the weapon's three acoustic sensor probes are extended and the two Avco Skeet self-forging fragment (SFF) warheads are armed. When a target is detected, classified and tracked by the probes, the onboard data processor calculates the target's future position and aims the first Skeet launcher towards this point. The Skeet is then launched, engaging the target from above with the SFF warhead; the ERAM has in the meantime swung back to start a sweep for another target.

Above: Once on the ground, the ERAM submunition deploys its three acoustic and infra-red sensors. Once an armoured vehicle is in range the mine fires one of its Skeet munitions (like a clay pigeon, hence the name) to explode directly over the target.

Left: ERAM before ground deployment. If the Skeets do not find a target once launched, they do not explode, but fall to the surface where they act as conventional mines. Thus ERAM can be used to attack both tank formations and lines of communication.

Above: An SUU (Suspended Underwing Unit) dispenser shows its load of ERAM submunitions. Each of the nine submunitions carries two Avco Skeet mines, each equipped with infra-red and acoustic sensors. When dropped the canister sheds its mines after deploying a parachute.

Above: Explosion of an anti-armour submunition after detecting a tank. By launching the weapon high in the air above the tank the explosion can be directed onto the weakest point in the armour of a modern tank, the top.

Above: The force of the exploding shaped charge forms a dart-shaped penetrator out of a disk of copper in the Skeet, which is then projected at very high velocity to the thinner top surface of the target. It can also explode upwards when run over by a tank.

USA

Hughes AGM-65 Maverick

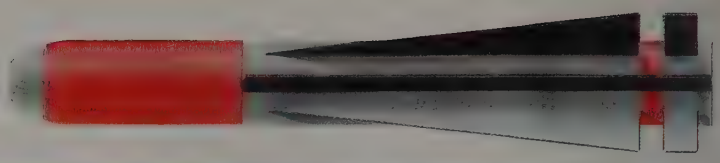
Smallest of the fully-guided launch-and-leave ASMs for the US services, the **Hughes AGM-65 Maverick** was originally a US Air Force programme but has now been adopted for both the US Navy and Marine Corps. The basic centroid TV homing version, the **AGM-65A**, entered US Air Force service in January 1972, and at least 30 were fired in combat during that year in Vietnam; another 69 were fired by Israeli pilots against Arab targets during the 1973 Yom Kippur War. Although scoring 87 hits, the missile was found to be severely limited in use because of the low magnification of its TV camera, which forced pilots to close to well within the maximum launch range in poor weather just to see the target clearly enough to achieve a lock-on. To overcome this problem the **AGM-65B** scene-magnification version was next produced. This has the TV image magnified to twice its previous size and made clearer, thus enabling the pilot to identify the target, lock-on the missile and fire it much more quickly and at a greater slant range than that of the AGM-65A.

The follow-on version was the **AGM-65C** for the US Marine Corps, which was laser-guided for use in the close-support role against targets designated by ground-based or airborne laser designators. The latter can be any of the Pave Knife, Pavé Penny, Pave Spike or Pave Tack systems, or even a compatible non-US designator.

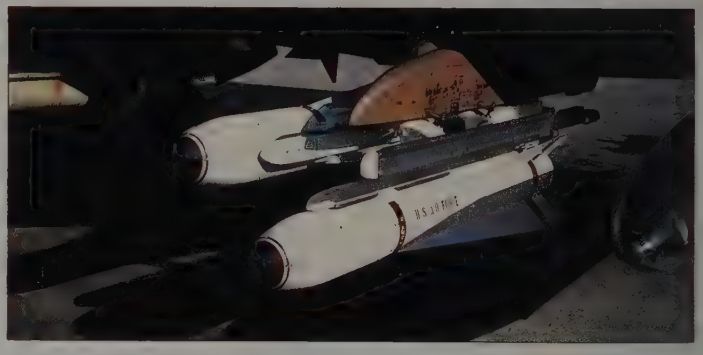
This weapon was superseded in 1982 by the **AGM-65E**, which has a 136-kg (300-lb) penetrating blast fragmentation warhead with a three-position selectable fuse delay.

In May 1977 Hughes began development for the US Air Force of the **AGM-65D** with an imaging IR seeker that enables the Maverick to lock on at a range at least twice the distance otherwise possible in European areas in mist and rain or at night. It will be the standard missile used with the LANTIRN night and adverse-weather detection system now being fitted to USAF General Dynamics F-16 Fighting Falcon fighter and Fairchild A-10 Thunderbolt II attack aircraft.

The US Navy will adopt the **AGM-65F**, which is essentially the same as the AGM-65D but with the warhead and fuse of the AGM-65E and modified guidance software to give maximum effects against surface ships. Weapons of the AGM-65 series are fielded by Egypt, Greece, Iran, Israel, Morocco, Saudi Arabia, Singapore, South Korea, Sweden, Switzerland, Taiwan, Turkey, US Air Force, US Navy, US Marine Corps and West Germany. Others are believed to be negotiating for the type.



Only 2.49 m (8 ft 2 in) long and weighing from 210 kg (463 lb), Maverick is the smallest fire-and-forget missile in the USAF's tactical inventory. It has been manufactured in a variety of guidance systems, including IR and laser.



Above: The standard Maverick can be locked on to a target by the pilot of the releasing aircraft centring the potential target on the monitor screen in his cockpit. The infra-red version has a similar method of operation, with the added advantage of being effective at night or in bad weather.

Right: Mavericks are loaded onto a Fairchild A-10 while on deployment to Egypt as part of a 'Bright Star' exercise. The missile is in use with the Egyptian air force as well as the air forces of 12 or more countries. Total production of TV Maverick alone is approaching 30,000 missiles.

Specification

AGM-65 Maverick

Type: air-to-surface missile

Dimensions: length 2.489 m (8 ft 2 in); span 0.719 m (2 ft 4.3 in); diameter 0.305 m (12 in)

Launch weight: 210 kg (463 lb) except AGM-65E/F 287.4 kg (633.6 lb)

Propulsion: solid-propellant rocket

Performance: speed subsonic; range between 0.9 and 24.2 km (0.56 and 15 miles); CEP about 1.5 m (5 ft) except AGM-65C/E which is less than this figure

Guidance: (AGM-65A/B) TV imaging, (AGM-65C/E) laser-homing and (AGM-65D/F) imaging IR

Warhead: 56.7-kg (125-lb) HE shaped charge except AGM-65E/F 136.1-kg (300-lb) HE penetrating blast fragmentation

A pair of AGM-65 Mavericks are carried under the wing of a McDonnell Douglas F-4 Phantom, the first aircraft to fire the missile in anger in Vietnam in 1972. Also used in the Yom Kippur war of 1973, the TV Maverick requires good viewing conditions to be most effective.

British Army Part 2

As with any army, that of the UK is divided into different arms of the service, but the British army retains a regimental system that extends beyond the old infantry and cavalry allocations to all other arms. Very basically a soldier joins the army into a regiment or corps, and then remains with it throughout the main part of his service career. This is particularly true of the cavalry and infantry units and to a lesser degree the technical or other arms. It is possible to transfer from one arm to another (e.g. from the Royal Artillery to the Army Air Corps), and officers can take staff postings as opposed to regimental postings. The 'teeth' arms will be considered first.

The Royal Armoured Corps (RAC)

The Royal Armoured Corps contains many of the old cavalry regiments plus the Royal Tank Regiment and is divided into armoured regiments, equipped with tanks, and armoured reconnaissance regiments, equipped with the Scorpion family of reconnaissance vehicles. The various regiments carry out tours of duty in their specific functions, and the Household Cavalry regiments in addition carry out tours of ceremonial duties interspersed with tours of combat duties. There are also two Territorial Army yeomanry regiments who carry out reconnaissance functions using the Fox reconnaissance vehicle. The RAC also operates the Swingfire long-range anti-tank guided missile.

The Infantry

The infantry regiments make up the main strength of the army, and there are in all 55 infantry battalions. Lumped together as divisions for administrative purposes, these battalions would be joined in emergency by a further 38 infantry battalions from the Territorial Army. The modern infantry battalion is a powerful force containing four (sometimes three) companies each of three platoons and a headquarters platoon. Each battalion has its own fire-support mortar platoon, an anti-tank element and a pioneer engineer platoon. The battalion is also equipped with night-vision equipment, its own signals element, and some battalions have variable weapons increments to suit local requirements. A new mobile anti-tank force equipped with Spartan/Milan is to be formed soon.

Infantry based in BAOR is classed as mechanized infantry and travels in the FV432, scheduled to be supplemented by the MCV-80. Some battalions based in the United Kingdom but scheduled for BAOR in time of war will use the new Saxon wheeled armoured personnel carrier. Infantry battalions based in the United Kingdom and elsewhere are based on the 4-tonne truck. The infantry includes the five battalions of the Brigade of Gurkhas.

The Royal Artillery (RA)

The Royal Regiment of Artillery includes the Honourable Artillery Company, the Royal Horse Artillery and the Royal Artillery. In practice the Royal Horse Artillery (RHA) operates in the same manner as the Royal Artillery, apart from acting as a standard-setter for the rest of the gunners, while the Honourable Artillery Company (HAC) is a Territorial Army unit with ceremonial, social and observation post functions.

The RA holds and fires the army's only nuclear weapons (Lance missiles and the 203-mm/8-in M110 self-propelled howitzer), both of which operate as part of BAOR. BAOR holds the bulk of the army's artillery strength, most of it self-propelled on tracks (M110, 175-mm/6.89-in M107, 155-mm/6.1-in M109A2 and 105-mm/4.13-in Abbot). Units based in the United Kingdom use either the 155-mm (6.1-in) FH-70 or the 105-mm (4.13-in) Light Gun, both of them towed weapons. Most of the 105-mm (4.13-in) and 155-mm (6.1-in) Field Regiments (regiment is the RA's term for a battalion-sized formation) has three batteries each with eight guns. The RA also has under its control Blowpipe/Javelin air defence missiles and the Towed and Tracked Rapier air-defence units. The RA also has its own locating regiment with surveillance drones, sound ranging and survey elements, and is soon to have its own computer-based command and control system. All batteries already have their own fire-control computers.

British reconnaissance regiments are equipped with the Alvis FV101 Scorpion, seen here exercising on Ascension Island. Powered by a military version of the Jaguar 4.2 litre engine, it has good acceleration and can reach 80 km/h (50 mph) on roads.

The Royal Engineers (RE)

The Royal Engineers help the rest of the army to move, live and fight, and basically provides military engineering support to the rest of the army (and the other services as well). They practice the whole range of combat and military engineering from the construction of battlefield obstacles, combat bridging, demolitions, water supplies, road building and repair, construction of fieldworks and shelters, mine warfare and clearing, and so on. For these purposes the RE is organized into field engineer regiments each with two or three squadrons, plus a field support squadron which acts as an equipment holding unit and also provides support when required. Specialist regiments include an armoured engineer regiment equipped with specialized armoured combat engineer vehicles and mobile bridges (the Centurion AVRE and the Chieftain AVLB), and an amphibious engineer regiment equipped with the M2 mobile bridge/ferry.

The RE also contain an explosive ordnance disposal (EOD or bomb disposal) regiment, a special postal and courier element, and a mapping and survey element, and also provide divers. There are also numerous other specialist units including the Military Works Force (MWF) which acts as a 'consultancy' service on many aspects of military construction and operations. The RE also have an inter-service function in the support of the RAF's Harrier squadrons.

The Rapier missile system is designed to destroy fast low-flying aircraft; its accuracy is such that warheads are fitted with an impact fuse. In 1981 the British army ordered a further 50 Rapier systems mounted on a version of the Ford Motor Corporation M548 Cargo Carrier.

British infantry sections are equipped with an L7 General Purpose Machine Gun, the British version of the Belgian Mitrailleuse d'Appui Général. The GPMG is also mounted on a tripod for sustained fire, using standard NATO 7.62 mm×51 ammunition; its cyclic rate of fire is 750-1000 rpm.

The Royal Signals

The role of the Royal Signals is to provide and maintain rapid, accurate and reliable communications for the army. Most units in the army are responsible for their own local communications, but the Royal Signals provide the large networks for higher command echelons and for long-distance communications. This service is provided in BAOR using signal regiments, some of which are at corps level with others at division level. At present the signal network is known as BRUIN, but this is now in the process of being replaced by the advanced PTARMIGAN system. The Royal Signals also provide long-range links with the United Kingdom and many overseas locations using artificial satellites, and also assist in the operation of communications within NATO.

The Royal Electrical and Mechanical Engineers (REME)

The REME act as the army's main repair and maintenance element to keep the army's wide range of equipment fit and ready for use. It thus has to be ready to repair anything from tanks and trucks to medical equipment and cameras. The REME's fitters and mechanics are integrated into almost every unit of the army from the infantry to the gunners, and may operate as part of a unit or as a mobile or static workshop associated with the unit. Many of the trades and skills used by REME are unique within the army.

The Royal Corps of Transport (RCT)

The role of the Royal Corps of Transport is much more than driving trucks, which is only one facet of the corps' activities. The corps also acts as the army's movements organizers and also gets involved in the operation of port, air movements and the provision of air logistic support. The driving tasks are mainly carried out by the RCT's Transport Regiment, which acts as the army's main load-carrier. The RCT also provides the army's ambulance carriers and contains the army's railway specialists, from drivers to railway operators. The RCT also has its own 'naval' arm with a specialist Maritime Regiment operating landing craft, logistics carriers and even a special ammunition-carrying ship. There are also some smaller craft under RCT control.

The Royal Army Ordnance Corps (RAOC)

The RAOC may be regarded as the army's storekeepers, but its operational role is much more than that of supplying stores from static locations. The RAOC moves wth the army wherever it travels or operates, and keeps the supplies of every conceivable item any unit might want, not only ready to hand but also in an operational condition. Many RAOC units are fully mobile and operate from trucks. The RAOC is also responsible for the supply of petrol, fuel and oils to the army, especially in BAOR where a supply pipe network has been established. Other RAOC responsibilities include the large-scale provision of some food (including bread from field bakeries) and the storage, maintenance and repair of all types of ammunition. The RAOC is also involved in the clearing of terrorist-type bomb and other devices in Northern Ireland and elsewhere.

The Medical Services

The army's medical services include the Royal Army Medical Corps (RAMC), the Royal Army Dental Corps (RADC) and Queen Alexandra's Royal Army Nursing Corps (QARANC). These units operate mainly from military hospitals or local garrison medical centres, but in time of war many of the personnel would move out to mobile field hospitals or to the various forward ambulance units.

The Special Air Service (SAS)

The SAS has had rather more public exposure in recent years than it would like, for normally it is a very specialized force used for much of the army's undercover work which would range from operating behind enemy lines to the surveillance and infiltration of terrorist groups. It requires a high level of physical and mental ability from its members, and tends to operate along its own particular lines. The SAS does not recruit from the general public.

The Intelligence Corps

Often known as the 'I Corps', this corps has two main functions: combat intelligence and security. Neither is easy to describe in a few words but basically combat intelligence is the provision of as much background information as possible of an enemy's equipment, methods and operating methods. Security refers to security within the army in the form of denying an enemy access to the army's premises and information.

The Royal Pioneer Corps

The Royal Pioneers Corps has now largely lost its old pick-and-shovel image as it now acts as the army's large-scale materials handling operatives in both stores and forward areas, and its officers also act as the army's management experts when dealing with civil operatives working within the army, e.g. on construction projects. The Pioneers also supply the army's dog handlers for guard duties but on occasion they can still act as the army's main large-scale labour force in support of other arms.

The Royal Military Police

The 'Red Caps' have largely lost their old unloved image as they now act mainly as the army's internal police force concerned with the day-to-day policing of all facets of military life. The MPs pride themselves in that they act as examples for other soldiers to follow, and their role in war would involve traffic control and the control of prisoners-of-war.

Other arms of the army include the Royal Army Education Corps, the Army Physical Training Corps, the Army Catering Corps, the Royal Army Chaplains' Department, the Gibraltar Regiment, the Royal Army Pay Corps and the Women's Royal Army Corps.

On the modern battlefield camouflage is of vital importance, but foliage and face paint are of little value when charging over open ground. This section is armed with the L1A1 Self-Loading Rifle, the British single-shot version of the Belgian FN Fusil Automatique Léger.

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Anti-Shipping Aircraft of World War II

Attacks against shipping around the war-zone coasts, and the incessant vigil against submarines, kept many aircraft busy throughout the war. These ranged from fighters to heavy bombers, all playing their part in denying the enemy freedom of the seas.

Japanese cargo ships plying the islands of the Dutch East Indies were faced with the constant threat of attack from Consolidated Liberators of the USAAF 13th Air Force, here seen strafing two ships caught in the open.

Of all the nations drawn into World War II during 1939 and 1940 none had more pressing needs of anti-shipping aircraft than the UK for, as a sea-girt power, her lifelines were critically vulnerable to attack from surface raider, submarine and aircraft alike. Yet responsibility for defence against this threat was, as had been for centuries, vested almost exclusively in the Royal Navy. Lip service had been paid to the RAF with the provision of such aircraft as the Avro Anson, while the Lockheed Hudson began arriving from America in 1939 to provide relatively long-range reconnaissance/attack muscle for Coastal Command.

As in so many of the wartime air forces, the emergence of the maritime strike role after the outbreak of hostilities brought about the demand for adaptation of obsolescent aircraft (fighters, bombers and even transports) to meet the operational requirements. The parameters of the requirements themselves were so broad (the equation of long-range navigation accuracy over featureless oceans, precision of attack equipment and a wide assortment of weapons which included cannon, depth charges, bombs, rockets and torpedoes) that no single aircraft could be considered ideal. Moreover, beyond the scope of this study were the other important anti-shipping aircraft, the minelayers.

It may be said that premeditated anti-shipping operations, as distinct from long-range anti-submarine attacks which were usually the result of chance sightings during tedious ocean patrols, were largely confined to the 'narrow seas' around Europe, from the North Cape of Norway to the Mediterranean, although the US and Japanese air forces also engaged in anti-shipping operations in the Pacific, particularly during the latter part of the war, as did the RAF in the Bay of Bengal.

Ignoring the relatively fruitless efforts by Bristol Blenheims and Ansons in the early months, the RAF began to achieve worthwhile successes when such aircraft as the Vickers Wellington, Bristol Beaufort and Bristol Beaufighter arrived in Coastal Command, while in the Axis air forces the Dornier Do 217 and Junkers Ju 88 proved fairly effective, particularly in operations against the Allied North Cape convoys, in which the Heinkel He 111 also participated. In the Savoia-Marchetti S.M.79 the Italians also possessed an excellent torpedo bomber which was flown to good effect against British shipping in the Mediterranean.

The Americans, however, were caught largely unprepared for anti-shipping tasks and so relied heavily on adaptation of the Boeing B-17 and Consolidated B-24, the latter's very long range suiting it admirably for ocean patrol and long-distance attack. Likewise the Japanese, despite embarking on their far-flung Pacific campaign, had assumed that carrierborne attack bombers would embrace the majority of maritime strike operations. Such was the nature of the organization of the Imperial Japanese Navy, however, that from the first days of the Pacific war considerable dependence was placed on land-based anti-shipping bombers, and it was the Mitsubishi G3M that participated in the successful attack on the British capital ships HMS *Prince of Wales* and HMS *Repulse*, one of the war's most successful air strikes against major warships at sea.

Manning a German minesweeper in the North Sea during 1944-5 was not the best of postings. Here an 'M' class boat receives the attention of Coastal Command Beaufighters armed with rockets and cannon. This action occurred north west of Borkum on 25 August 1944.

UK

Avro Anson

Anachronistic relic of pre-war RAF expansion, the **Avro Anson** was originally the result of a coastal reconnaissance aircraft requirement, and was developed from a six-seat commercial aircraft. It first flew on 24 March 1935 and, powered by Cheetah engines, the **Anson Mk I** entered service with No. 48 Squadron in March 1936, and was the first RAF aircraft with a retractable landing gear, albeit manually operated. The Anson subsequently served with 12 squadrons of Coastal Command up to the beginning of the war, when the first Lockheed Hudsons were just beginning to arrive from America. Nevertheless Ansons were retained on short-range coastal reconnaissance duties in diminishing numbers until 1942, occasionally having brushes with the enemy. By the beginning of the war, however, the Anson was already in use as an aircrew trainer for navigators, wireless operators and air gunners, and it was for this long and priceless service that the 'faithful Annie' is best remembered. Jacobs- and Wright-powered **Anson Mk III** and **Anson Mk IV** aircraft were shipped to Canada to equip the growing numbers of flying schools under the Commonwealth Air Training Scheme. Canadian manufacturers also producing the **Anson Mks II, V** and **VI**. Light transport conversions from the Anson Mk I resulted in the **Anson Mks X, XI** and **XII**, some of which were employed as air ambulances; the **Anson Mk XI** was powered by Cheetah XIX engines driving Fairey-Reed metal propellers, and the **Anson Mk XII** had Cheetah XVs driving constant-speed Rotol propellers. Production, which continued after the war with the **Anson Mks 19, 20, 21** and **22**, reached a total of 11,020 aircraft, including 2,822 built in Canada.

Avro Anson GR.Mk I of No. 220 Sqn, Coastal Command, in the overall silver pre-war paint scheme.

Ever on the alert, an Anson of No. 48 Sqn keeps watch on a convoy out of Liverpool. At the outbreak of war, the Anson formed the bulk of Coastal Command's fleet. No. 48 Sqn was based at Hooton Park to protect the Western Approaches.

Specification

Avro Anson Mk I

Type: three-seat general-reconnaissance aircraft

Powerplant: two 350-hp (261- kW) Armstrong Siddeley Cheetah IX radial piston engines

Performance: maximum speed 303 km/h (188 mph) at 2134 m (7,000 ft); initial climb rate 219 m (720 ft) per minute; service ceiling 5791 m (19,000 ft); range 1271 km (790 miles)

Weights: empty 2438 kg (5,375 lb); maximum take-off 3629 kg (8,000 lb)

Dimensions: span 17.22 m) (56 ft 6 in); length 12.88 m (42 ft 3 in); height 3.99 m (13 ft 1in); wing area 43.01 m^2 (463.0 sq ft)

Armament: one fixed forward-firing 7.7-mm (0.303-in) machine-gun in nose and one 7.7-mm machine-gun in dorsal turret, plus provision to carry up to 163 kg (360 lb) of bombs

UK

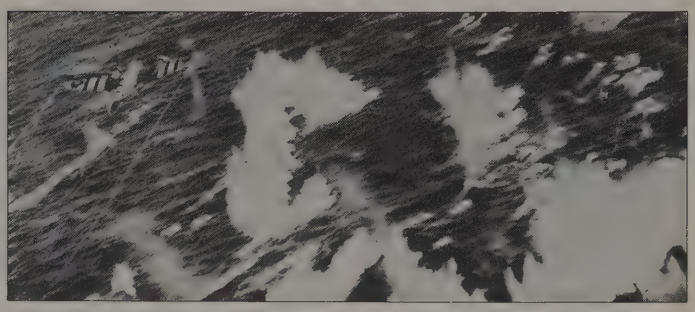
Bristol Beaufighter

To a large extent responsible for the defence against the German Blitz of 1940-1 as the RAF's first purpose-built night-fighter, the **Bristol Beaufighter** remained in service as such almost to the end of the war. Such was its performance, however, that in 1941 it also came to be developed, first as an intruder and, as a natural follow-on, a specialist anti-shipping strike aircraft. It was moreover no stranger to RAF Coastal Command, the **Beaufighter Mk IC** having been specially prepared as a long-range maritime fighter with additional navigation and radio equipment. The **Beaufighter Mk VIC** with 1,650-hp (1230.4-kW) Hercules VI or XVI radials featured for the first time an additional dorsal machine-gun to provide token defence against enemy fighters which Coastal Command squadrons frequently encountered over the Bay of Biscay.

As early as March 1941 a Beaufighter Mk I underwent trials with a torpedo, and in September the following year another aircraft was fitted with 76.2-mm (3-in) rocket projectiles. Two months later the first Beaufighter Strike Wing was formed at North Coates, Lincolnshire, comprising No. 143 Squadron (Beaufighter fighters), No. 236

Bristol Beaufighter TF.Mk X of No. 455 Sqn armed with eight underwing, unguided rockets.

Towards the end of the war, the unguided rocket became the major anti-shipping weapon, especially against the small targets often encountered in the Channel. These were usually ripple-fired.



Beaufighters were particularly accurate against shipping, proving to be a steady platform during the diving attack. As well as serving in home waters, the Beaufighter had great success against Japanese shipping.

Squadron (Beaufighter bombers with a pair of 113- or 227-kg/250- or 500-lb bombs) and No. 254 Squadron ('Torbeau' torpedo-carrying Beaufighters). By the spring of 1943 the wing was in frequent action against German supply ships sailing between enemy-held ports in the North Sea. In May that year rocket-firing Beaufighter Mk VICs entered service, their principal task being to attack escorting *Flak* ships while the torpedo aircraft and bombers went for the enemy merchantmen.

As the Beaufighter was gradually replaced in service as a night-fighter its importance as a maritime strike aircraft grew. The **Beaufighter TF.Mk X** was introduced with ASV (air-to-surface vessel) radar and carried universal racks which enabled combinations of bombs, rockets and torpedo to be carried. Strike Beaufighters served with a total of 11 home-based Coastal Command squadrons, and seven in the Middle East. The aircraft reached the Far East in January 1943 and soon afterwards began to re-equip five strike squadrons (Nos 22, 27, 177, 211 and 217), proving deadly when flown against Japanese shipping being sailed along the Burma coast.

Specification
Bristol Beaufighter TF.Mk X
Type: two-seat torpedo-strike fighter
Powerplant: two 1,770-hp (1319.9-kW) Bristol Hercules XVII 14-cylinder air-cooled radial piston engines
Performance: maximum speed 488 km/h (303 mph) at 396 m (1,300 ft); climb to 1524 m (5,000 ft) in 3.5 minutes; service ceiling 4572 m (15,000 ft); normal range 2366 km (1,470 miles)
Weights: empty 7076 kg (15,600 lb); maximum take-off 11431 kg (25,200 lb)
Dimensions: span 17.63 m (57 ft 10 in); length 12.70 m (41 ft 8 in); height 4.82 m (15 ft 10 in); wing area 46.73 m^2 (503 sq ft)
Armament: four 20-mm Hispano cannon in nose and one 7.7-m (0.303-in) machine-gun in dorsal position, plus either eight 76.2 mm (3-in) rocket projectiles and two 227-kg (500 lb) bombs or a single 748-kg (1,650-lb) or 965-kg (2,127-lb) torpedo

Beaufighter attack! Trailing vortices from its wingtips, this 'Beau' is pulling out from its strike against a German ship. Further aircraft behind it succeed in turning the water white.

UK

Bristol Beaufort

Until superseded by the torpedo-carrying Beaufighter, the **Bristol Beaufort** was the RAF's standard torpedo-bomber from 1940 to 1943, replacing the aged Vickers Vildebeest biplane. First flown on 15 October 1938, the **Beaufort Mk I**, of which early versions were powered by 1,010-hp (753.2-kW) Bristol Taurus II radials (later replaced by Taurus VIs), joined No. 22 Squadron in December 1939 and carried out their first minelaying sortie on 15-16 August 1940. Beauforts also dropped the RAF's first 907-kg (2,000-lb) bomb on 7 May. Total production of the Beaufort Mk I was 965, and this version was followed by the **Beaufort Mk II** with American Pratt & Whitney Twin Wasp radials, production continuing until 1943, by which time 415 had been produced. The final Beaufort Mk IIs were completed as trainers with the two-gun dorsal turret deleted. Beauforts equipped six Coastal Command squadrons in the United Kingdom and four in the Middle East, their most famous operations being carried out against the German warships *Scharnhorst* and *Gneisenau* on 6 April 1941 in Brest harbour (which earned a posthumous VC for Flying Officer K. Campbell of No. 22 Squadron), and during the warships' escape up the English Channel early in 1942. Beauforts were also very active while based on Malta, attacking Axis shipping being sailed to North Africa. The **Beaufort Mks V-IX** were built in Australia for the RAAF in the Far East, production totalling 700.

Bristol Beaufort Mk I of No. 22 Sqn, Coastal Command. No. 22 Sqn was the first in service with this torpedo-bomber. Despite early problems, it went on to provide useful service.

Specification
Bristol Beaufort Mk I
Type: four-seat torpedo-bomber
Powerplant: two 1,130-hp (842.6-kW) Bristol Taurus VI radial piston engines
Performance: maximum speed 426 km/h (265 mph) at 1829 m (6,000 ft); service ceiling 5029 m (16,500 ft); range 2575 km (1,600 miles)
Weights: empty 5942 kg (13,100 lb); maximum take-off 9629 kg (21,228 lb)
Dimensions: span 17.62 m (57 ft 10 in); length 13.49 m (44 ft 3 in); height 4.34 m (14 ft 3 in); wing area 46.73 m^2 (503.0 sq ft)
Armament: two 7.7-mm (0.303-in) machine-guns in nose and dorsal turret (some aircraft had a rear-firing machine-gun under the nose and two in beam-firing positions), plus a bombload up to 907 kg (2,000 lb) or one 728-kg (1,605-lb) 457-mm (18-in) torpedo

No. 217 Sqn flew its Beauforts from Malta, and these were responsible for many of the problems faced by Axis shipping in the Mediterranean. Only one torpedo could be carried, but the aircraft possessed bombing and minelaying capability.

UK

de Havilland Mosquito

In much the same manner that the Beaufighter came to be introduced into RAF Coastal Command as an anti-shipping strike fighter, so the classic **de Havilland Mosquito** achieved considerable success in this role, being used principally with rocket projectiles and bombs. A torpedo-carrying version was under development at the end of the war.

It was not until the Mosquito had been successfully developed as a fighter-bomber (effectively combining its night-fighter cannon armament with its ability to carry bombs internally) that the **Mosquito FB.Mk VI** was selected for service with Coastal Command, trials being undertaken at Boscombe Down with an aircraft fitted with eight 76.2-mm (3-in) rocket projectiles under the wings. In addition to a nose armament of four 20-mm and four 7.7-mm (0.303-in) guns, the Mosquito FB.Mk VI could also carry a pair of short-finned 227-kg (500-lb) bombs in the rear of the bomb bay; alternatively, later aircraft were strengthened to carry a further pair of 227-kg (500-lb) weapons under the wings in place of the rockets.

Following the success of the Beaufighter anti-shipping strike wings in 1943, a Mosquito Strike Wing was formed at Banff in Scotland before the end of that year, No. 333 (Norwegian) Squadron being the first to receive Mosquito FB.Mk VIs in November. No. 248 Squadron followed in the next month, and No. 235 in June 1944. Employed almost exclusively against enemy shipping off the Norwegian coast, the Norwegian pilots of No. 333 Squadron usually flew as pathfinders for the wing, leading Mosquito formations along the winding fjords in search of German vessels.

Of greater interest than true operational value was the **Mosquito FB.Mk XVIII** anti-shipping strike aircraft, armed with a single 57-mm Molins gun in the nose. A converted Mosquito FB.Mk VI thus armed made its first flight on 25 August 1943, after which 27 production aircraft were built and entered service with No. 248 Squadron at Banff in January 1944. Detachments were sent south for patrols over the English Channel and on 25 March a Mosquito FB.Mk XVIII pilot attacked and claimed to have sunk an enemy submarine off the French coast. Weighing over 907 kg (2,000 lb), the Molins gun was not considered a success as its recoil constantly caused local structural damage in the Mosquito's nose. No. 248 Squadron retained its aircraft until February 1945, after which the survivors were handed over to No. 254 Squadron at North Coates for the remainder of the war.

Specification

de Havilland Mosquito FB.Mk VI

Type: two-seat anti-shipping strike fighter

Powerplant: two 1,230-hp (917.2-kW) Rolls-Royce Merlin XXI 12-cylinder liquid-cooled inline piston engines

Performance: maximum speed 612 km/h (380 mph) at 3962 m (13,000 ft); climb to 4572 m (15,000 ft) in 7.0 minutes; service ceiling 10972 m (36,000 ft); normal range 2092 km (1,300 miles)

Weights: empty 6486 kg (14,300 lb); maximum take-off 10115 kg (22,300 lb)

Dimensions: span 16.51 m (54 ft 2 in); length 12.34 m (40 ft 6 in); height 4.63 m (15 ft 3 in); wing area 40.41 m^2 (435 sq ft)

Armament: four 20-mm and four 7.7-mm (0.303-in) guns in the nose, plus either two 227-kg (500-lb) bombs and eight 76.2-mm (3-inch) rocket projectiles or up to four 227-kg (500-lb) bombs

As effective as the Beaufighter, the de Havilland Mosquito was also used in low-level rocket and strafing attacks against shipping. No. 143 Sqn flew its FB.Mk VIs from Banff in Scotland against shipping off Norway.

UK

Vickers Wellington and Warwick

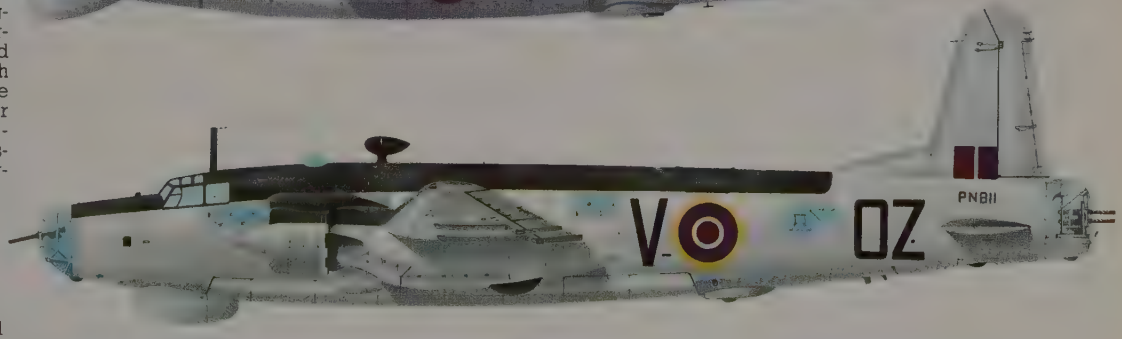
The famous **Vickers Wellington** bomber enjoyed a long and valuable career with RAF Coastal Command in a number of roles, not least in the maritime general reconnaissance role, a term that euphemistically embraced anti-shipping duties. Apart from a small number of Wellingtons equipped for mine-exploding in 1940, Coastal Command's first aircraft specifically prepared for maritime work were **Wellington Mk VIII** machines developed in 1941 for use with the Leigh Light for illuminating surfaced U-boats, particularly in the Bay of Biscay; the first such aircraft were delivered to No. 221 Squadron in the Mediterranean in January 1942, however. ASV radar came to be fitted in some Mk VIIIs (which were in effect conversions of the Wellington Mk IC bomber), but the **Wellington GR.Mk XI** employed the improved airframe of the Wellington Mk X and was capable of carrying a wide range of anti-submarine weapons including two 190.5-kg (420-lb) depth charges or a single 457-mm (18-in) torpedo. The **Wellington GR.Mk XII** was also equipped with a Leigh Light, which retracted into an aperture in the midships fuselage structure. The **Wellington GR.Mk XIII**, intended for daylight use only, omitted the Leigh light but carried two 457-mm (18-in) torpedoes in addition to ASV Mk III radar, while the **Wellington GR.Mk XIV** could carry depth charges or bombs, and featured Leigh Light and ASV Mk III for night operations. Anti-shipping Wellingtons remained in service for the remainder of the war, serving on a total of 21 squadrons at home, in the Mediterranean and Middle and Far East.

A bomber development was the **Vickers Warwick** which, overtaken by technological progress, never survived to serve as such; instead it, like

The Vickers Wellington GR.Mk XIV was the final version of this able aircraft used by Coastal Command. This example is a Mk XIV issued to No. 304 (Polish) Squadron in 1944.

the Wellington, came to be developed for maritime duties. However, although it gave considerable service with Coastal Command in the air-sea rescue role from 1943 onwards, lengthy delays in development (and shortage of Centaurus engines) prevented the **Warwick GR.Mk V**, with Leigh Light and ASV, from entering service with No. 179 Squadron until November 1944; this squadron flew anti-submarine patrols over the Bay of Biscay and the Western Approaches during the last three months of the war.

Specification
Vickers Wellington GR.Mk XIII
Type: six/seven-seat anti-shipping/submarine aircraft
Powerplant: two 1,735-hp (1293.8-kW) Bristol Hercules XVII air-cooled radial piston engines
Performance: maximum speed 406 km/h (252 mph) at 1219 m (4,000 ft); climb to 1219 m (4,000 ft) in 6.9 minutes; service ceiling 4877 m (16,000 ft); normal range 2816 kg (1,750 miles)
Weights: empty 9974 kg (21,988 lb); maximum take-off 14107 kg (31,100 lb)
Dimensions: span 26.26 m (86 ft 2 in); length 19.68 m (64 ft 7 in); height 5.38 m (17 ft 8 in); wing area 78.04 m² (840 sq ft)
Armament: two 7.7-mm (0.303-in) machine-guns in nose turret and four in tail turret, and some aircraft mounted two machine-guns in fuselage beam positions, plus an offensive load of either bombs and depth charges up to 2041 kg (4,500 lb) or two 457-mm (18-in) torpedoes



The Warwick GR.Mk V did not enter service until late 1944. It carried ASV radar and a Leigh light and was used over the Bay of Biscay on anti-submarine patrols. This aircraft served with No. 179 Sqn.

Transmitting and receiving aerials for the ASV Mk II radar adorn this Wellington on routine patrol over the Mediterranean. This radar enabled the aircraft to detect small objects projecting above the surface, such as submarine conning towers.

USA

Boeing B-17 Fortress

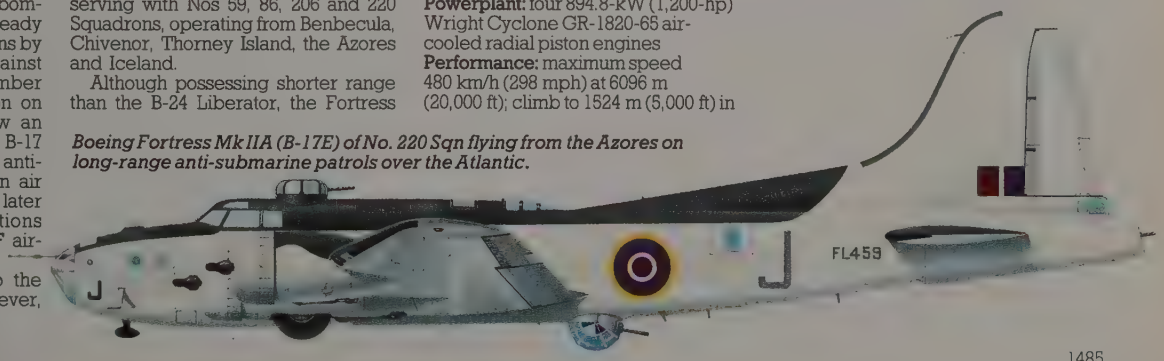
America's enforced entry into World War II undoubtedly caught her air forces unprepared for maritime operations, and the sudden appearance of long-range U-boats off her eastern seaboard and in the Caribbean caused some 122 aged Douglas B-18Bs to be deployed on anti-submarine patrols along the coasts of the USA. Meanwhile, however, the **Boeing B-17D Fortress**, which had supplanted the B-18 in service with the USAAC's heavy bombardment groups in 1941, had already pioneered anti-shipping operations by this aircraft with an attack against Japanese vessels on 10 December 1941. This was the first occasion on which American aircrews flew an offensive mission. No specialist B-17 version was produced for the anti-shipping role with the American air forces, the machines that were later employed in maritime operations being standard **B-17E** and **B-17F** aircraft.

Fortresses were supplied to the RAF in fairly large numbers, however, and after a period of inauspicious service as bombers the survivors of a batch of 20 **B-17C (Fortress Mk I)** aircraft were pressed into service with Nos 206 and 220 Squadrons of Coastal Command for maritime reconnaissance duties over the Western Approaches. Starting in mid-1942 about 150 of the improved B-17E were delivered to Coastal Command as the **Fortress Mk II** and **Fortress Mk IIA**, serving with Nos 59, 86, 206 and 220 Squadrons, operating from Benbecula, Chivenor, Thorney Island, the Azores and Iceland.

Although possessing shorter range than the B-24 Liberator, the Fortress contributed considerably to the patrol efforts demanded by the frequent sailing of wartime convoys, particularly at the height of the great U-boat campaign in the Atlantic. RAF Fortresses were employed on anti-shipping strike missions, their weapons being almost entirely confined to depth charges.

Specification
Boeing Fortress Mk II
Type: eight-seat maritime reconnaissance aircraft
Powerplant: four 894.8-kW (1,200-hp) Wright Cyclone GR-1820-65 air-cooled radial piston engines
Performance: maximum speed 480 km/h (298 mph) at 6096 m (20,000 ft); climb to 1524 m (5,000 ft) in 7.5 minutes; service ceiling 10363 m (34,000 ft); normal range 1835 km (1,140 miles)
Weights: empty 12542 kg (27,650 lb); maximum take-off 24041 kg (53,000 lb)
Dimensions: span 31.62 m (103 ft 9 in); length 22.50 m (73 ft 10 in); height 5.84 m (19 ft 2 in); wing area 131.92 m² (1,420 sq ft)
Armament: total of 10 12.7-mm (0.5-in) machine-guns in nose, dorsal, ventral, tail and beam positions, plus a normal bombload of up to 2722 kg (6,000 lb) of bombs and/or depth charges

Boeing Fortress Mk IIA (B-17E) of No. 220 Sqn flying from the Azores on long-range anti-submarine patrols over the Atlantic.



Battle of the Bay

Nowhere was the maritime air war fought more fiercely than over the cold, grey seas of the Bay of Biscay. It became the most valuable area of sea around Europe, as Doenitz's dreaded U-boats were harboured around its margins. The RAF flew as many missions as possible to deny them access to the Atlantic.

For reasons that will quickly become apparent, the most vicious fighting of the Battle of the Atlantic (insofar as air fighting was concerned) occurred over the Bay of Biscay, that expanse of water off France's western seaboard so well known for its frequent, treacherous storms and heavy seas. It was the possession of that west-facing coast, with its large ports (Brest, St Nazaire, La Rochelle and Bordeaux) gained by Germany in 1940, that enabled the U-boats to operate far out in the Atlantic without the dangerous and fuel-consuming voyage through the North Sea to and from the German home ports. Of course the French bases attracted the growing attention of RAF Bomber Command, and enormous damage was done to the port facilities, but the German Todt organization was quick to construct vast covered concrete submarine pens that were impervious to anything but a direct hit by the heaviest bomb.

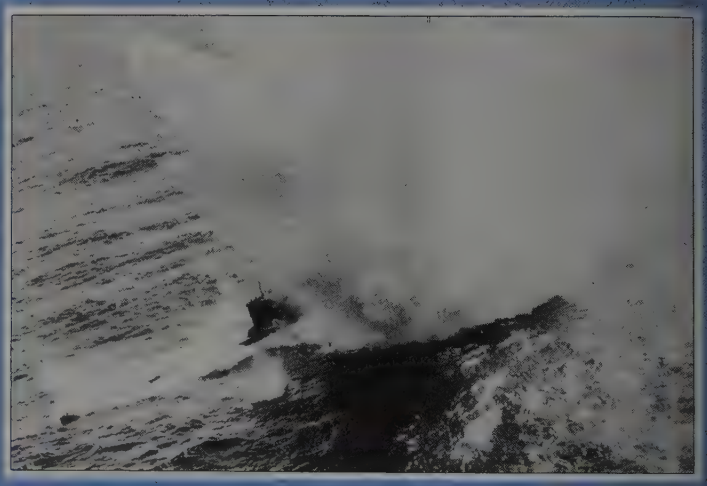
Thus it fell to RAF Coastal Command aircrews to operate constant patrols over the Bay of Biscay, maintaining day and night vigilance for enemy submarines setting out for and returning from their ocean forays. Other tasks included keeping watch for German blockade runners, sneaking home from distant ports with vital raw materials, as well as surface raiders which ranged from battle-cruisers such as the *Scharnhorst* and *Gneisenau* to armed merchantmen.

During the early months of the war the RAF was hard pressed to find aircraft of sufficient range to perform worthwhile patrols over the Bay, and still carry adequate armament to attack a ship and to defend themselves if attacked by enemy aircraft. These difficulties were emphasized by the escape of the German warships, *Scharnhorst*, *Gneisenau* and *Prinz Eugen*, from Brest in February 1942. To cover such an eventuality Coastal Command was able to operate patrols by no more than three Lockheed Hudsons whose crews, for a variety of reasons, failed to spot the enemy ships.

The year 1942 nevertheless brought about profound improvements in Coastal Command's ability to tackle the Bay of Biscay more effectively. The Leigh Light was introduced, first in the Vickers Wellington and later in all manner of other aircraft, enabling patrolling crews to spot U-boats as they recharged their batteries on the surface at night. This, used in conjunction with early search radar (ASV), though slow to bring about the destruction of enemy submarines, nevertheless made U-boat captains much less willing to risk sudden attack from the air and, by forcing them to spend more time submerged while in transit to and from their killing grounds, did much to reduce their patrol range. And, although such aircraft as old Armstrong Whitworth Whitley bombers still flew patrols over the Bay, new aircraft like the Bristol Beaufighter were joining Coastal Command to afford protection for the lumbering flying-boats.

An isolated incident serves to illustrate the hazards and difficulties of operations in the Bay. On the night of 11 August 1942 a Leigh Light Wellington of No. 172 Squadron, flown by Flying Officer A.W.R. Trigg, suffered engine failure and had to ditch in high seas. All six crew members managed to clamber into their dinghy, and the following afternoon they were sighted by the crew of a Whitley which dropped a spare dinghy and a Thornaby Bag survival kit. Soon afterwards a Short Sunderland arrived to pick up the ditched crew, escorted by three Beaufighters. Surviving a run-in with a Focke-Wulf Fw 200, the Sunderland crashed on alighting and most of the crew were engulfed by the rough sea. A day passed as the Luftwaffe prevented further Whitleys from reaching the Wellington's crew; then a storm blew up, preventing any air activity over the dinghy for three days, during which the airmen had to contend with an inquisitive shark. At mid-day on 16 August a Beaufighter and Hudson arrived, dropping a

Although not serving in the same numbers as the Beaufighter, the Mosquito was every bit as effective against shipping. Here a U-boat in the Bay receives the treatment from a Mosquito FB.Mk VI.



Hit! A depth charge from a Coastal Command aircraft finds its mark in the Bay of Biscay. The U-boat was lounging on the surface when the pilot spotted it and dropped several charges.

Lindholme gear and signalling that a destroyer was coming. At this point the Wellington crew discovered that one of the Sunderland's men had survived in a dinghy nearby, and lashed it to their own. As the destroyer approached, its escorting Beaufighters shot down a Ju 88, only to be set on by Focke-Wulf Fw 190s. Early on 17 August a German launch, escorted by Arado Ar 196 seaplanes and Fw 190s, appeared but, occupied by attacks by the Beaufighters, they were unable to prevent the destroyer from recovering the ditched airmen. Despite constant attacks by Luftwaffe aircraft, the British ship and its escort returned safely to their Cornish bases.

It was such air activity as this that marked the deployment of additional German forces in France not only to protect the U-boat bases but to dispute Coastal Command's increasing anti-submarine operations in the Bay. However, the early metric ASV radar was not proving equal to the task of identifying surfaced U-boats as the presence of French fishing vessels in the Bay showed up on the screens with much the same effect as a conning tower. In January 1943, therefore, Consolidated Liberators began operating ASV Mk III which, originating from an American centimetric AI radar, was able to provide better definition of surface objects.

The increasing success in attacking surfaced U-boats, scarce though these attacks were, led to a new phase in the submarine war by the beginning of 1943, when enemy captains chose to remain surfaced and fight it out with the aircraft, and once more casualties among Coastal Command aircraft (which were forced to attack from low level) began to climb steadily. This was a disturbing turn of events, for statistics prepared at the time suggested that of every hundred or so sightings of enemy submarines fewer than half were attacked, and no more than one or two boats were confirmed as sunk. And while 1942 had brought transformation to the equipment available to fight the U-boat, the Battle of the Atlantic would have to be won in 1943 if the build-up of forces in the UK for the invasion of Europe was to be sustained, a view forcibly expressed at the Casablanca conference early that year. Agreement with the Americans over operational priorities proved difficult, and although they promised to provide six anti-shipping/submarine Liberator squadrons, only three arrived and then too late to make any significant contribution to the Battle of the Bay. Yet, paradoxically it fell largely to the Liberator (with RAF Coastal Command) to win the battle.

In mid-1943 U-boats began operating in packs and were escorted through the Bay by relays of Ju 88C night-fighters. In June no more than 57 submarine sightings were reported, and only two were sunk by aircraft. The German boats then started hugging the Spanish coast to leave the Bay, a course that placed them out of range of all but the Liberator, and when the Royal Navy stepped up its surface patrols the Luftwaffe countered by introducing the Henschel Hs 293A rocket-propelled guided missile, launched by the Do 217s of KG 100. By August, however, the tide had turned. Growing experience with ASV Mk III was producing good results and night attacks on U-boats were shredding the nerves of their crews. In three summer months of 1943 56 U-boats were sunk in the Atlantic, 23 of them in the Bay. It was at this time that the Azores were made available by the Portuguese as a base for Coastal Command aircraft, the first of two U-boats being sunk by Azores-based Liberators in October.

By the end of the year the U-boat menace was being mastered. Allied shipping losses, which had stood at a monthly total of more than half a million tons in mid-1942, fell to an average of about 130,000 tons per month in the latter half of 1943. As the invasion of France approached, so the patrols over the Bay by Coastal Command tightened the blockade against the U-boat. By the date of the Normandy landings no enemy submarine could possibly approach the invasion area from the Biscay bases without almost certain destruction, and scarcely any did. Within three months western France had been cleared of the enemy and Admiral Doenitz's much depleted U-boat fleet was once more forced back into the confines of the North Sea. The Battle of the Bay had been won.

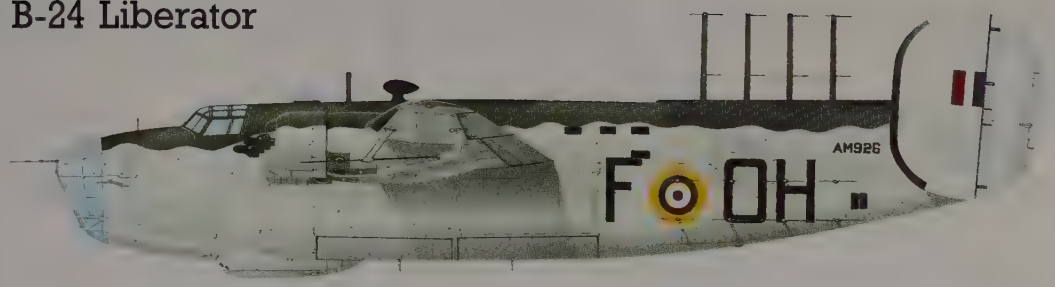
USA

Consolidated B-24 Liberator

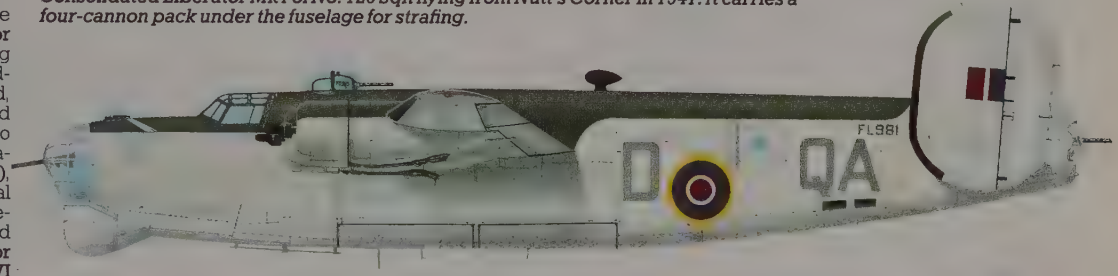
With its long-range performance the **Consolidated B-24 Liberator**, when introduced into service in the maritime reconnaissance role, did more than any other aircraft to turn the tide in the Allies' favour in the long Battle of the Atlantic, effectively 'closing the gap' between the patrol areas of east- and west-based aircraft and thereby denying German U-boats (and surface vessels) a vast tract of ocean in which they had been wholly safe from air attack.

First to use the B-24 in the maritime role, was the RAF whose first **Liberator Mk I** aircraft reached the UK during March 1941 and joined No. 120 Squadron at Nutts Corner, Northern Ireland, in June of that year. These were joined by the **Liberator Mk II** (equivalent to the **B-24C**) in December 1941, and later by the **Liberator Mk III (B-24D)**, these three versions equipping a total of 16 RAF squadrons. Subsequent deliveries to Coastal Command included the **Liberator Mk IV (B-24E), Liberator GR.Mk V (B-24G), Liberator GR.Mk VI (B-24G** and **B-24H)** and **Liberator GR.Mk VIII**. With well over 1,000 Liberators flying with RAF maritime reconnaissance squadron in almost every war theatre, it was to be expected that their achievements should be unsurpassed in the war's ocean struggle. For example, in November 1942 the Liberators of No. 224 Squadron in the Bay of Biscay sank two U-boats which were manoeuvring to attack the troop convoys sailing for the 'Torch' landings, attacks that would otherwise have caused enormous casualties among the troops. In March 1945 Liberators of five RAF squadrons sank seven U-boats in six days. Like other RAF maritime patrol aircraft Liberators were widely equipped with the Leigh Light, and other aircraft were armed with rocket projectiles and batteries of cannon for use against submarines.

In US Navy service the Liberator served as the **PB4Y-1**, 977 such aircraft being delivered. A developed version, the **PB4Y-2 Privateer**, entered service with at least one squadron, VP-24, some PB4Y-2Bs being armed with an ASM-N-2 Bat anti-shipping glide bomb under each wing. Total Privateer production amounted to 736 aircraft.



Consolidated Liberator Mk I of No. 120 Sqn flying from Nutt's Corner in 1941. It carries a four-cannon pack under the fuselage for strafing.



Liberator GR.Mk V of No. 224 Sqn in November 1942. This was the RAF version of the B-24G, and introduced greater range and armament over its predecessor.

PB4Y-1 Liberator of VPB-110, US Navy based in Devon, during the winter of 1944. Such US units provided a much-needed back-up to the Coastal Command squadrons.

Specification

Consolidated PBY-1 Liberator

Type: 10-seat maritime patrol bomber
Powerplant: four 1,200-hp (894.8-kW) Pratt & Whitney R-1830-43 or -65 air-cooled radial piston engines
Performance: maximum speed 449 km/h (279 mph) at 8077 m (26,500 ft); climb to 1219 m (4,000 ft) in 7.8 minutes; service ceiling 9693 m (31,800 ft); normal patrol range 4764 km (2,960 miles)
Weights: empty 16761 kg (36,950 lb); maximum take-off 27216 kg (60,000 lb)
Dimensions: span 33.53 m (110 ft 0 in); length 20.50 m (67 ft 3 in); height 5.46 m (17 ft 11 in); wing area 97.36 m² (1,048 sq ft)
Armament: eight 12.7-mm (0.5-in) machine-guns in nose, dorsal and tail turrets and waist hatches amidships, plus up to 5806 kg (12,800 lb) of bombs, mines or depth charges

Arriving in service late in the war, the Consolidated PB4Y-2 Privateer was developed from the Liberator, the main difference being the single fin. These mainly saw action in the Far East and continued in use for many years after the war's end.

Lockheed PV-1/PV-2 in Action

Derived from the civil Model 18, and leading on naturally from the Hudson, Lockheed's Ventura and Harpoon performed sterling work for the US Navy and Royal Air Force on coastal patrols, with the aircraft's strength and performance often overcoming stiff opposition.

The performance and offensive capabilities of the US Navy's Ventura and Harpoon belie their designation as patrol aircraft, a term usually associated with the long-range Consolidated Catalina and Martin Mariner flying-boats. The PVs were fast, heavily armed, and carried impressive bomb loads. For defence, their speed and manoeuvrability, backed by the Martin twin 12.7-mm (0.5-in) top deck turret plus a pair of 7.62-mm (0.3-in) weapons in the belly, proved to be a combination enemy pilots quickly learned to respect. Ventura pilots fired the bow guns; a pair of 12.7-mm guns supplemented later by a 'chin gun' kit with three additional 12.7-mm weapons for AA fire suppression during glide and low-level bombing attacks and for attacks on enemy aircraft. In addition to normal patrol squadron operations (maritime surveillance, anti-submarine patrols and convoy escort), the PVs were regularly called on to exploit their attack capabilities in bombing, rocket and strafing runs on ships and ground installations.

While the PVs were the US Navy's primary land-based patrol aircraft during World War II, the path to their successful operation was a difficult one, especially for the Ventura. Introduced to the fleet in late 1942 and early 1943, the early PV-1 squadrons had little transition training and lost a number of crews and aircraft as a result of this inadequate preparation to cope with the demands of this high-performance aircraft. A 322.3-kg/m^2 (66-lb/sq in)) wing loading, 2,000-hp (1491.4-kW) engines and a minimum single-engine control speed of some 222 km/h (138 mph) were a far cry from the forgiving, 167-km/h (104-mph) PBYs from which most of the crews came. In addition to their inexperience, early Ventura crews were well aware of the poor reputation their aeroplane had acquired earlier during its limited service in the RAF and in the USAF.

On the basis of a successful evaluation of the PBO-1 Hudson by Patrol Squadron 82 (VP-82) during 1941, the US Navy was committed to land-based patrol planes. The Ventura was in production and available, and was a logical choice to fill the requirement. In the event, the US Navy accepted the type for fleet service and also assumed the administration of the contracts with Lockheed. First deliveries to the US Navy were 27 Ventura Mk IIs, requisitioned from British production in September 1942. These aircraft, with RAF equipment installed, were designated PV-3 and were assigned to Patrol Squadron 82. With their Hudson experience behind it, the US Navy's first landplane patrol squadron quickly completed the transition to the Hudson's successor. Later squadrons, with no landplane experience, were not so fortunate and experienced considerable difficulty in adapting to the Ventura.

Atlantic operations against the sub

On completing PV training, VP-82 crews were deployed to Argentia, Newfoundland, to continue the battle against the German U-boats, but not until April 1943 were their efforts rewarded. On 27 April VB-125 (ex-VP-82) scored the Ventura's first victory when Lieutenant Thomas Kinaszczuk sank *U-174* off Newfoundland. The crew, escorting a convoy, was circling ahead of the ships when the pilot sighted a wake about 19.3 km (12 miles) away. Kinaszczuk headed for what he identified as a submarine on the surface and alerted the crew for an attack. At a range of about 2.4 km (1.5 miles) the submarine opened fire, hitting the PV on the starboard wing with what was probably 20-mm explosive shells. Disregarding the damage and the AA fire, the pilot pressed his attack on the crash-diving U-boat and dropped all four 147.4-kg (325-lb) depth bombs close-aboard the submarine's hull. Three of the bombs exploded alongside the boat and the fourth just forward of the bow. As the plane circled, the crew saw the submarine settling. After about two minutes, the bow of the sub surfaced at a steep angle, settling as the boat continued forward at very slow speed. The sub's bow abruptly rose until it was almost vertical, then the U-boat slipped beneath the surface. About two minutes later, there was a violent eruption of air and oil in a huge mushroom on the surface, followed by continuous bubbling until the plane left the area.

US Navy Venturas operating from Caribbean and Brazilian bases fought the Battle of the South Atlantic against the U-boats during 1943 and 1944, when the submarines were at the peak of their capability. VB-127 was credited with the sinking of *U-591* on 30 July 1943 off the coast of Brazil. On 11 August, PV-1s of VB-129 teamed with Liberators from VB-107 and the USS *Moffett* to sink *U-604* in the South Atlantic. The next victim of the ASW forces was *U-615*, sunk in the Caribbean on 6 August by VB-130 Venturas and PBM Mariners from VP-204 and 205.

Operations in the Pacific

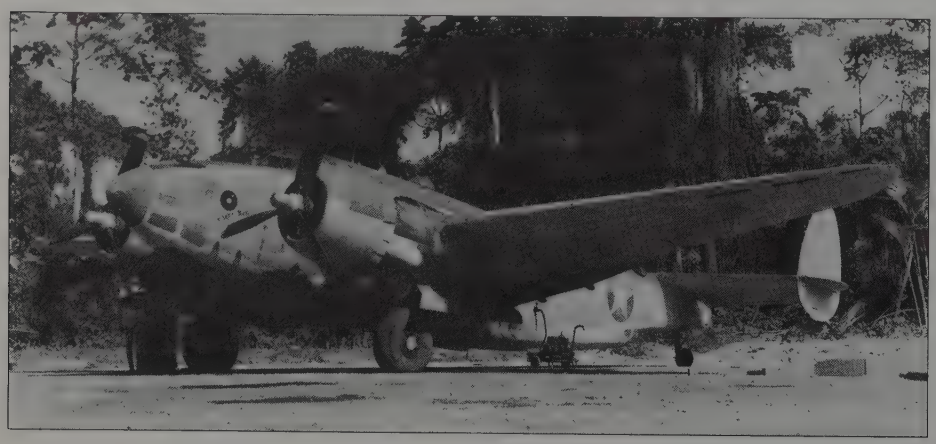
Venturas joined the battle with the Japanese when VB-137 was deployed in May 1943 to Samoa and the Ellice islands, where the squadron flew typical patrol squadron missions. In August, VB-140 pushed PV operations westward, to the Solomons, and began flying from fabled Henderson Field. As the war moved to the west, the squadron moved to the Russells where it was joined by VB-138 in October. The two squadrons pioneered strike tactics there that would be employed by Ventura squadrons for the remainder of the war.

In late 1943 combat activity shifted to the Central Pacific with the landings on Tarawa. The PVs followed, with VB-142 arriving on Tarawa on 21 December, just one month after the landings by the US Marines. The squadron flew patrols and strikes on enemy bases in the Marshalls. Attacks against convoys attempting to supply the bases resulted in 11 ships and a number of small craft sunk or heavily damaged during the first months of the new year. On 12 January 1944 VB-144 arrived on Tarawa to share the responsibilities for maintaining pressure on the enemy. Following the US landings on Kwajalein and Majuro, the two PV squadrons concentrated on neutralizing the bypassed enemy bases in the Marshalls. The threat of raids by enemy bombers staging through the islands was significant, and frequent attacks on the runways and facilities were made to assure their continued neutralization.

Tactics employed by the Venturas usually were glide bombing runs by formations of three or six aircraft in line abreast, all releasing bombs in train. The formation approached the target at 1829 to 2438 m (6,000 to 8,000 ft) altitude, pushing over into a 30° to 45° dive with speeds reaching as much as 556 km/h (345 mph) indicated. The pilot released the bombs, usually six 227 kg (500 lb) sighting through the ring and bead sight mounted in front of the windshield. Pullout was completed at 914 to 1524 m (3,000 to 5,000 ft) to avoid exposure to automatic weapons fire.

Low-level bombing or photo flights required a high speed pass over the target at 30.5 m (100 ft) or less and planes were hit frequently by automatic weapon fire. A VB-144 Ventura was hit during such a run over Wotje. A single projectile came through the nose of the plane and exploded in the cockpit, killing the pilot instantly and demolishing his controls. The copilot took over and completed the run, then flew the PV back to Tarawa for a safe landing. His feat was remarkable in that he was a replacement pilot who had just joined the squadron and this was his first landing in a Ventura!

In the South Pacific, the island-hopping campaign continued to move the war to the west. VB-148 was at Munda in New Georgia in April, then moved forward to Emirau late in May. On 1 June 1944, Lieutenant Metke was assigned a search sector near the Western Carolines.



Ready to go; a US Navy PV-1 Ventura waits for its crew at Bougainville in the Solomons. When they were on board, they could look forward to a long, arduous patrol of many hours.

Ventura Mk II of No. 21 Sqn, RAF, operating from Methwold in Norfolk. Venturas entered service with the RAF in November 1942, and one of their first large missions was against the Philips concern at Eindhoven on 6 December. Venturas suffered high losses while used as bombers.

Lockheed PV-1 of VB-135, US Navy, operational over the Pacific in 1944. Approximately 1,600 PV-1s were procured by the Navy during the war.

The end of hostilities was not the end of the Ventura, and some continued in service for many years. This example was flown as a target tug by the Royal Canadian Air Force in the 1950s. Others were converted into executive business transports.

South of the major enemy base at Truk, the crew sighted and engaged a Mitsubishi G4M 'Betty' bomber, shooting it down. A week later, Lieutenant Harry Stanford scored, shooting another 'Betty' down with the PV's bow guns. For variety, on 26 July Lieutenant Metke spotted a five-ship convoy south west of Truk and attacked it with the only weapons he had, namely depth bombs. His contact report alerted the squadron and a six-plane strike was launched which destroyed three of the ships and damaged a fourth. Next day, another strike sank a fourth ship and turret gunner Leonard Wheatley, in one of the attacking Venturas, shot down a Kawasaki Ki-61 'Tony' fighter flying cover for the ships.

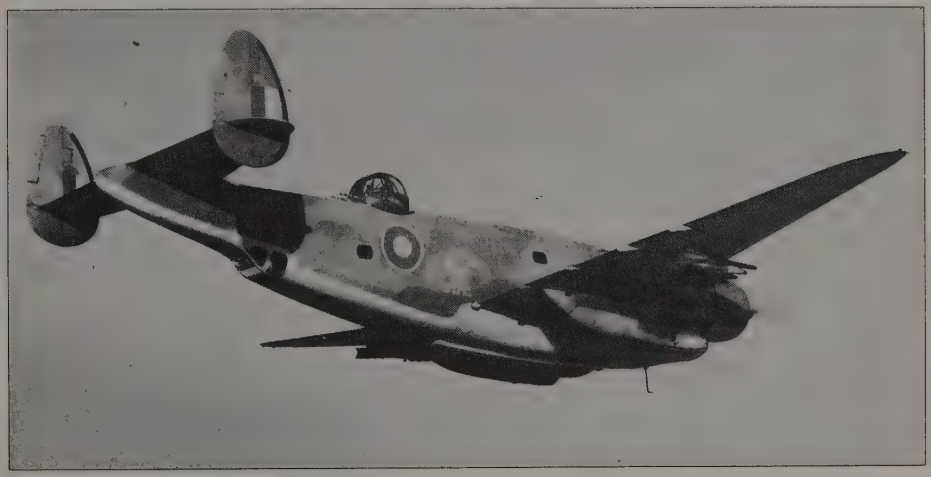
Reoccupation of the Marianas later in 1944 provided new bases and marked the high point of Pacific theatre PV operations. Routine search flights were supplemented by frequent strikes on enemy island bases. In early 1945, the PVs began strikes against Japanese picket boats stationed south of the home islands to provide early warning of incoming Boeing B-29 raids. During one such attack by a VPB-133 Ventura, both pilots were seriously injured by AA fire from the target boat. The aircraft crew provided first aid to the pilots, then succeeded in flying the PV back to Iwo Jima where the crew chief landed the plane safely!

VPB-133 search flights from Iwo Jima included tracks over the home islands, with the opportunity for attacks on coastal shipping, trains, bridges and tunnels. On 13 May, Lieutenant-Commander Jack Coley attacked two ships and destroyed two locomotives with 127-mm (5-in) rockets during a sweep over Honshu. On 28 May Coley found and attacked an eight-ship convoy but was hit by AA fire and was forced to shut down one engine. Damage to fuel tanks eventually forced him to ditch the PV alongside a 'Lifeguard' submarine on station north of Iwo. Coley and all of his crew were rescued, uninjured.

The PV-2 Harpoons first appeared in the Western Pacific when VPB-142 arrived on Tinian in May 1945. On 27 June, on a typical search flight, Lieutenant Janes and his crew had completed the outbound leg of their assigned sector and were turning for home when they passed from a cloud into a clear area

Venturas were active over most of the Pacific theatre on both anti-submarine and anti-shipping duties. At the northernmost range of their activities were the Aleutian Islands, where these aircraft are seen along with a PBY Catalina.

Although used primarily by the RAF as a bomber, the Ventura was used on occasion for maritime duties, especially later on in the war. This example carries unguided rocket projectiles under the wings. The fuselage legend reads 'Got 'em on the run'.



Lockheed PV-1/PV-2 in Action

and spotted a surfaced Japanese submarine. Janes pushed over in a diving turn and as the PV approached, the submarine crew finally became aware of the imminent attack and started a crash dive. As the Harpoon crossed the target, its deck still awash, Janes dropped three depth bombs for a perfect straddle. As the Harpoon circled, the crew watched the submarine sink in a circle of debris and oil. Post-war analysis of Japanese records confirmed the sinking and identified the boat as the *I-165*.

VPB-144, VPB-148 and VPB-153 also returned to the Western Pacific with PV-2s for second combat deployments. At war's end, more than half the US Navy land-based patrol squadrons were equipped with Harpoons.

Although arriving late in the war, the PV-2 Harpoon was a much improved aircraft over the PV-1, featuring increased range, withering firepower, manoeuvrability and high speed for a low-level bomber.

gunner could fire. As Marlin pulled ahead of the fighter, the stinger gunner opened up on it for the coup de grace!

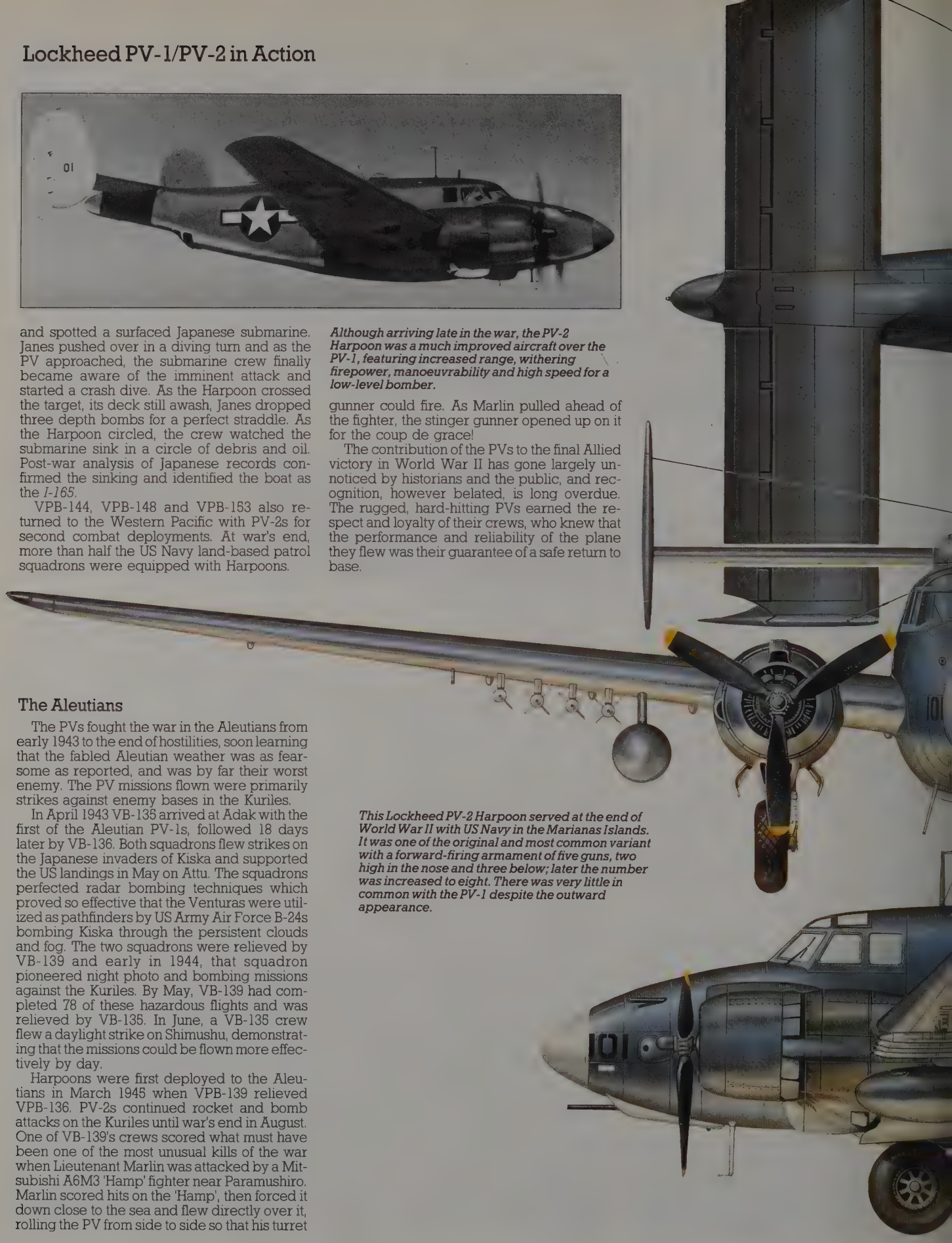
The contribution of the PVs to the final Allied victory in World War II has gone largely unnoticed by historians and the public, and recognition, however belated, is long overdue. The rugged, hard-hitting PVs earned the respect and loyalty of their crews, who knew that the performance and reliability of the plane they flew was their guarantee of a safe return to base.

The Aleutians

The PVs fought the war in the Aleutians from early 1943 to the end of hostilities, soon learning that the fabled Aleutian weather was as fearsome as reported, and was by far their worst enemy. The PV missions flown were primarily strikes against enemy bases in the Kuriles.

In April 1943 VB-135 arrived at Adak with the first of the Aleutian PV-1s, followed 18 days later by VB-136. Both squadrons flew strikes on the Japanese invaders of Kiska and supported the US landings in May on Attu. The squadrons perfected radar bombing techniques which proved so effective that the Venturas were utilized as pathfinders by US Army Air Force B-24s bombing Kiska through the persistent clouds and fog. The two squadrons were relieved by VB-139 and early in 1944, that squadron pioneered night photo and bombing missions against the Kuriles. By May, VB-139 had completed 78 of these hazardous flights and was relieved by VB-135. In June, a VB-135 crew flew a daylight strike on Shimushu, demonstrating that the missions could be flown more effectively by day.

Harpoons were first deployed to the Aleutians in March 1945 when VPB-139 relieved VPB-136. PV-2s continued rocket and bomb attacks on the Kuriles until war's end in August. One of VB-139's crews scored what must have been one of the most unusual kills of the war when Lieutenant Marlin was attacked by a Mitsubishi A6M3 'Hamp' fighter near Paramushiro. Marlin scored hits on the 'Hamp', then forced it down close to the sea and flew directly over it, rolling the PV from side to side so that his turret



This Lockheed PV-2 Harpoon served at the end of World War II with US Navy in the Marianas Islands. It was one of the original and most common variant with a forward-firing armament of five guns, two high in the nose and three below; later the number was increased to eight. There was very little in common with the PV-1 despite the outward appearance.

Keith Fretwell

USA

Lockheed PV-1/PV-2 Ventura/Harpoon

The success of the Hudson in RAF service led Lockheed to propose a military version of the larger Lockheed 18 Lodestar and resulting British interest led to development of the **Lockheed 37**. During 1940 a total of 675 of these aircraft was contracted for the RAF, which named the type **Ventura**, and the company lost little time initiating production in the Vega factory. By comparison with the Hudson, the Ventura had far more effective armament, a heavier bombload and more powerful engines, and appeared to have considerable potential. First used operationally by the RAF on 3 November 1942, the type was soon found to be unsuited to daylight operations and was transferred to Coastal Command. Nevertheless, the Ventura was procured in large numbers under Lend-Lease, and was built for the US Army Air Force and US Navy, this last service designating it the **PV-1 Ventura**. Venturas served with all the Commonwealth nations, the Free French and with the Brazilian air force. A long-range version, the **PV-2**, had been ordered by the US Navy in June 1943 and, differing in several respects from the Ventura, was named **Harpoon**; Ventura and Harpoon production totalled 3,028 in September 1945. Post-war surplus PV-2 aircraft were supplied to Italy, Japan, the Netherlands, Peru and Portugal.

Specification

Lockheed PV-1 Ventura

Type: maritime patrol aircraft

Powerplant: two 2,000-hp (1491-kW) Pratt & Whitney R-2800-31 radial piston engines

Performance: maximum speed 518 km/h (322 mph) at 4205 m (13,800 ft); service ceiling 8015 m (26,300 ft); normal range 2189 km (1,360 miles)

Weights: empty 9161 kg (20,197 lb); maximum take-off 14096 kg (31,077 lb)

Dimensions: span 19.96 m (65 ft 6 in); length 15.77 m (51 ft 9 in); height 3.63 m (11 ft 11 in); wing area 51.19 m² (551.0 sq ft)

Armament: two 12.7-mm (0.5-in) forward-firing machine-guns, two similar guns in dorsal turret and two 7.72-mm (0.3-in) machine-guns in ventral position, plus up to 1361 kg (3,000 lb) of bombs, or six 147-kg (325-lb) depth charges, or one torpedo

USA

Lockheed Hudson (A-28/-29)

Originating in 1938, when the UK was spending considerably more money on contracts with the American aircraft industry than the US air forces themselves, the **Lockheed Hudson** was the outcome of a request that the Lockheed 14 transport be developed as a maritime reconnaissance aircraft. The first such aircraft was flown on 10 December 1938, and the first to arrive in the UK was disembarked at Liverpool on 15 February 1939. After the initiation of the Lend-Lease programme the aircraft was given the US designation **A-28** and **A-28A**, some of the British aircraft being repossessed as **A-29** and **A-29A** aircraft by the USAAF after Pearl Harbor. The first U-boat to be sunk by American forces was attacked by an A-29 of the 13th Bomb Group. An attack trainer version was produced as the **AT-18** (or, with dorsal turret removed, the **AT-18B**). It was however in the RAF that the aircraft, as the Hudson, saw most service. The original order for 200 (soon increased to 350) aircraft were designated **Hudson Mk I**; Hydromatic propellers identified the **Hudson Mk II**, and the **Hudson Mk III** was powered by 1,200-hp (984.8-kW) Wright GR-1820 G205A radials. Hudsons entered service with the RAF's No. 224 Squadron in mid-1939, replacing Avro Ansons, and thereafter flew constant patrols over the North Sea; later, with the arrival of the Hudson Mk III with extra fuel tanks, the aircraft participated in the Battle of the Atlantic. It was the crew of a No. 269 Squadron Hudson to whom the U-boat *U-570* surrendered after a determined attack on 27 August 1941. A total of 2,487 Hudsons was purchased on British contracts, of which 423 were supplied to Canada, South Africa, China, New Zealand, Australia and Portugal. Final versions were the **Hudson Mks IV, V** and **VI** with Pratt & Whitney radials. Hudsons equipped 31 RAF squadrons, serving as transports in the final years of the war.

Specification

Lockheed A-29 (Hudson Mk IIIA)

Type: four-seat light bomber

Powerplant: two 1,200-hp (894.8-kW) Wright R-1820-87 radial piston engines

Performance: maximum speed 407 km/h (253 mph) at 4572 m (15,000 ft); climb to 3048 m (10,000 ft) in 6.3 minutes; service ceiling 8077 m (26,500 ft); range 2494 km (1,550 miles)

Weights: empty 5817 kg (12,825 lb); maximum take-off 9299 kg (20,500 lb)

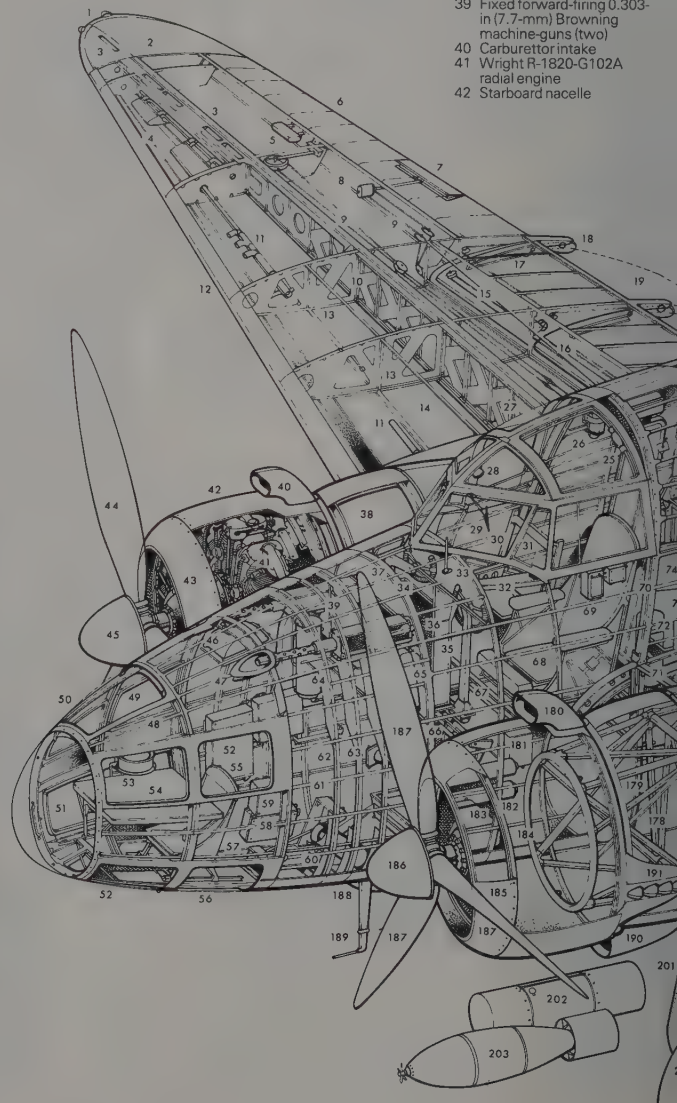
Dimensions: span 19.96 m (65 ft 6 in); length 13.51 m (44 ft 4 in); height 3.63 m (11 ft 11 in); wing area 51.19 m² (551.0 sq ft)

Armament: two 7.62-mm (0.3-in) machine-guns each in nose and dorsal turrets, and one 7.62-mm (0.3-in) machine-gun in vertical position, plus a bombload of 1,600 lb (726 kg)

Hudsons performed sterling work for Coastal Command during the war, usually in home waters. Their good endurance and adequate weapon load made them especially useful in the battle against the U-boat. This pair are pictured whilst on an anti-shipping patrol in the Heligoland Bight.

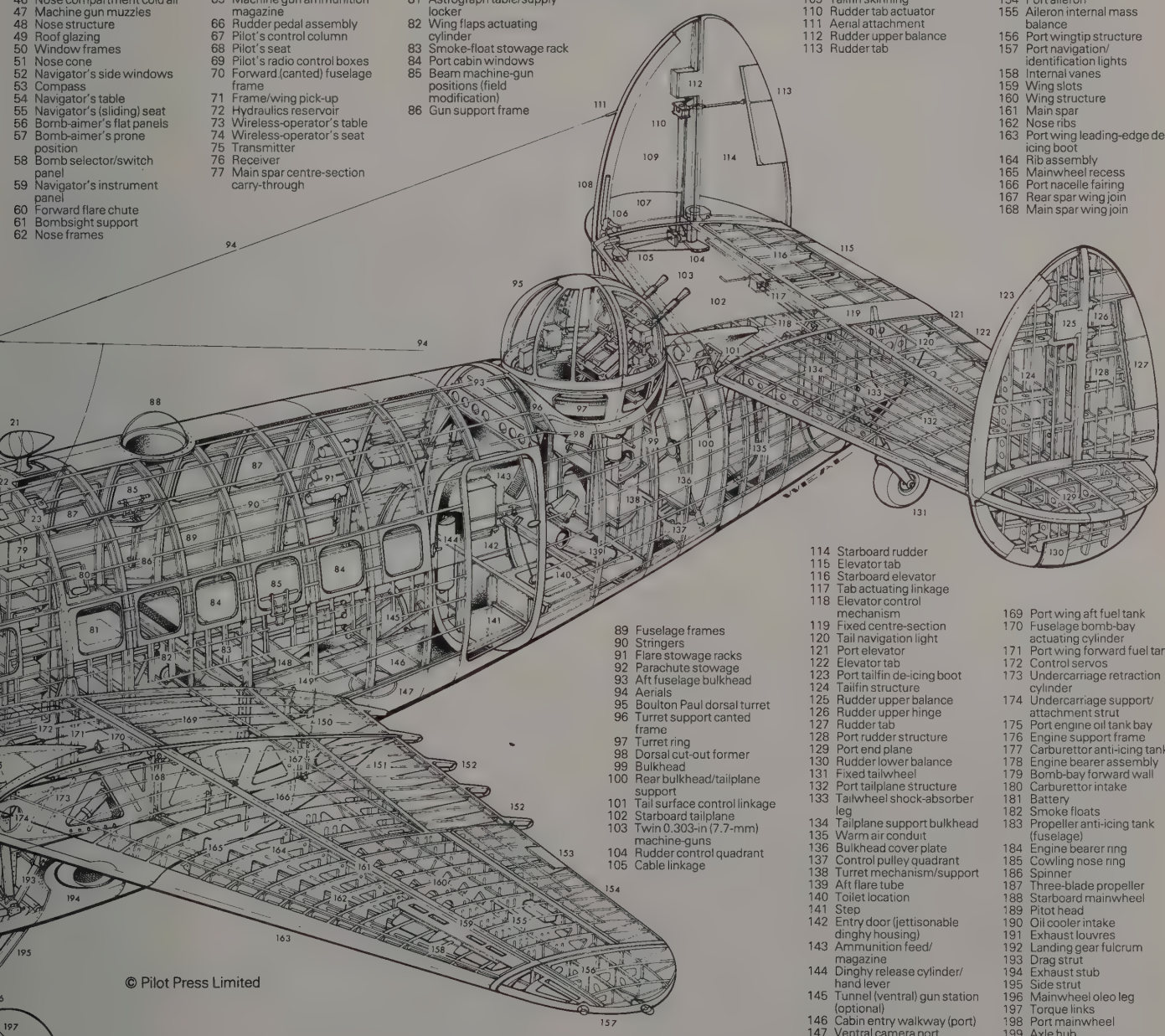
Lockheed Hudson Mk I cutaway drawing key

1 Starboard navigation/ identification lights
2 Starboard wingtip
3 De-icing slots
4 Internal vanes
5 Aileron internal mass balance
6 Starboard aileron
7 Aileron tab
8 Tab mechanism
9 Control cables
10 Wing main spar structure
11 De-icing tubes
12 Leading-edge de-icing boot
13 Main wing rib stations
14 Wing skinning
15 Flap control cbles
16 Flap tracks
17 Flap cables/pulleys
18 Track fairings
19 Port flap (extended)
20 Aerial mast
21 D/F loop fairing
22 Supported structure
23 Aerial lead-in
24 Cockpit cold air
25 Flight deck sun-blind frames
26 Windscreen wiper motor
27 Jettisonable canopy hatch
28 Console light
29 Windscreen wipers
30 Second-pilot's jump seat
31 Adjustable quarterlight
32 Windscreen frame support member
33 External gunsight
34 Second-pilot's (back-up) control column (cantilevered)
35 Central instrument console
36 Starboard nose compartment entry tunnel
37 Bulkhead
38 Starboard engine oil tank
39 Fixed forward-firing 0.303-in (7.7-mm) Browning machine-guns (two)
40 Carburettor intake
41 Wright R-1820-G102A radial engine
42 Starboard nacelle



Another useful role filled by the Hudson was air-sea rescue. This Hudson Mk III of No. 279 Sqn flew from Sturgate during 1942, equipped with a ventral lifeboat which could be dropped to airmen downed in the North Sea. The aircraft would then signal a ship or flying-boat to come and pick them up.

43 Cowling nose ring
44 Three-blade propeller
45 Spinner
46 Nose compartment cold air
47 Machine gun muzzles
48 Nose structure
49 Roof glazing
50 Window frames
51 Nose cone
52 Navigator's side windows
53 Compass
54 Navigator's table
55 Navigator's (sliding) seat
56 Bomb-aimer's flat panels
57 Bomb-aimer's prone position
58 Bomb selector/switch panel
59 Navigator's instrument panel
60 Forward flare chute
61 Bombsight support
62 Nose frames
63 Nose compartment warm air
64 Windscreen de-icing tank
65 Machine gun ammunition magazine
66 Rudder pedal assembly
67 Pilot's control column
68 Pilot's seat
69 Pilot's radio control boxes
70 Forward (canted) fuselage frame
71 Frame/wing pick-up
72 Hydraulics reservoir
73 Wireless-operator's table
74 Wireless-operator's seat
75 Transmitter
76 Receiver
77 Main spar centre-section carry-through
78 Spar/frame attachment
79 Wireless bay racks
80 Cabin cold air
81 Astrograph table/supply locker
82 Wing flaps actuating cylinder
83 Smoke-float stowage rack
84 Port cabin windows
85 Beam machine-gun positions (field modification)
86 Gun support frame
87 Starboard cabin windows
88 Astrodrome (Mk III and retrofit)
106 De-icing tube
107 Starboard end plane
108 Tailfin de-icing boot
109 Tailfin skinning
110 Rudder tab actuator
111 Aerial attachment
112 Rudder upper balance
113 Rudder tab
151 Port flap section
152 Flap track fairings
153 Aileron tab
154 Port aileron
155 Aileron internal mass balance
156 Port wingtip structure
157 Port navigation/identification lights
158 Internal vanes
159 Wing slots
160 Wing structure
161 Main spar
162 Nose ribs
163 Port wing leading-edge de-icing boot
164 Rib assembly
165 Mainwheel recess
166 Port nacelle fairing
167 Rear spar wing join
168 Main spar wing join



89 Fuselage frames
90 Stringers
91 Flare stowage racks
92 Parachute stowage
93 Aft fuselage bulkhead
94 Aerials
95 Boulton Paul dorsal turret
96 Turret support canted frame
97 Turret ring
98 Dorsal cut-out former
99 Bulkhead
100 Rear bulkhead/tailplane support
101 Tail surface control linkage
102 Starboard tailplane
103 Twin 0.303-in (7.7-mm) machine-guns
104 Rudder control quadrant
105 Cable linkage
114 Starboard rudder
115 Elevator tab
116 Starboard elevator
117 Tab actuating linkage
118 Elevator control mechanism
119 Fixed centre-section
120 Tail navigation light
121 Port elevator
122 Elevator tab
123 Port tailfin de-icing boot
124 Tailfin structure
125 Rudder upper balance
126 Rudder upper hinge
127 Rudder tab
128 Port rudder structure
129 Port end plane
130 Rudder lower balance
131 Fixed tailwheel
132 Port tailplane structure
133 Tailwheel shock-absorber leg
134 Tailplane support bulkhead
135 Warm air conduit
136 Bulkhead cover plate
137 Control pulley quadrant
138 Turret mechanism/support
139 Aft flare tube
140 Toilet location
141 Step
142 Entry door (jettisonable dinghy housing)
143 Ammunition feed/magazine
144 Dinghy release cylinder/hand lever
145 Tunnel (ventral) gun station (optional)
146 Cabin entry walkway (port)
147 Ventral camera port
148 Ventral gun well
149 Bomb-doors operating quadrant
150 Bomb-bay rear well
169 Port wing aft fuel tank
170 Fuselage bomb-bay actuating cylinder
171 Port wing forward fuel tank
172 Control servos
173 Undercarriage retraction cylinder
174 Undercarriage support/attachment strut
175 Port engine oil tank bay
176 Engine support frame
177 Carburettor anti-icing tank
178 Engine bearer assembly
179 Bomb-bay forward wall
180 Carburettor intake
181 Battery
182 Smoke floats
183 Propeller anti-icing tank (fuselage)
184 Engine bearer ring
185 Cowling nose ring
186 Spinner
187 Three-blade propeller
188 Starboard mainwheel
189 Pitot head
190 Oil cooler intake
191 Exhaust louvres
192 Landing gear fulcrum
193 Drag strut
194 Exhaust stub
195 Side strut
196 Mainwheel oleo leg
197 Torque links
198 Port mainwheel
199 Axle hub
200 Towing lug
201 Undercarriage door
202 Float marker
203 250-lb (113.5-kg) A/S bomb

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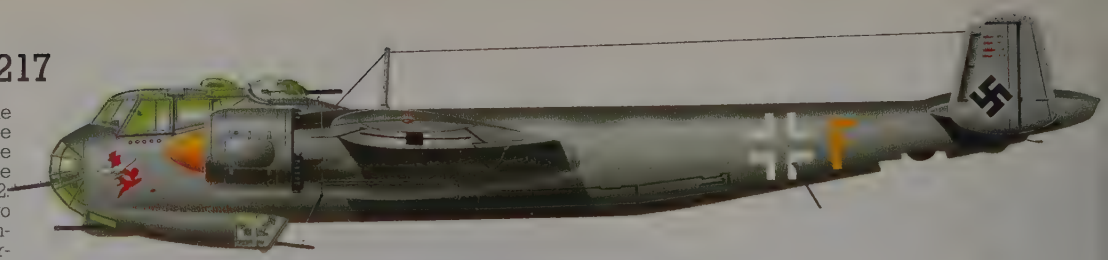
GERMANY

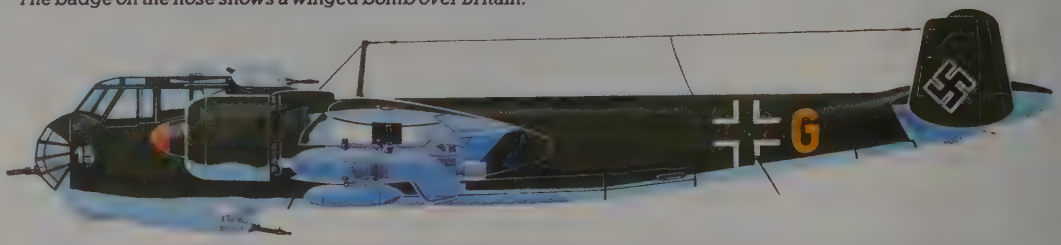
Dornier Do 217

After the departure eastwards of the bulk of Germany's light bombing force from western Europe in May 1941, the principal bomber unit remaining in the Netherlands was Kampfgeschwader 2. This unit by itself was inadequate to sustain a prolonged bombing campaign against the UK, but was nevertheless re-equipped with a new version of the Do 17, the **Dornier Do 217**. At about the same time the specialist anti-shipping unit in the West, KG 40, received its first Do 217s, II/KG 2 receiving **Do 217E-1** aircraft in August 1941. Although these aircraft were fundamentally standard bombers, concessions were soon forthcoming to suit the aircraft to the anti-shipping role with the issue of *Rüstsätze* (conversion kits); among these were the R-10 and R-15 kits to enable the Do 217E to mount anti-shipping weapons, later to include the Henschel Hs 293A guided missiles; the **Do 217E-5** was designed from the outset to accommodate these weapons. Other anti-shipping variants were the **Do 217K-2** equipped to deliver two Fritz X rocket-propelled missiles, and the **Do 217K-3** capable of carrying either Hs 293As or Fritz Xs. Sub-variants of the **Do 217M** were also produced for the anti-shipping role.

In mid-1943 II and III/KG 100 were withdrawn from the Eastern Front and re-equipped with Do 217E-5s and Do 217K-2s respectively, the former unit moving to Cognac with Hs 293As and the latter to Marseilles with the Fritz X. The first success in action was gained on 27 August when Hs 293As sank the Canadian destroyer HMCS *Athabaskan* and the corvette HMS *Egret* in the Bay of Biscay. In the Mediterranean III/KG 100 sank the Italian battleship *Roma* and damaged the *Italia* with Fritz Xs on 9 September; shortly afterwards Major Bernhard Jope (the pilot who, in a Fw 200, had fatally damaged the *Empress of Britain* back in October 1940) discharged a Fritz X against HMS *Warspite*, putting the battleship out of action. In terms of Allied shipping sunk or severely crippled, the Do 217 was unquestionably the most effective of all German anti-shipping aircraft when armed with these guided weapons.



Dornier Do 217E-2 of 9.Staffel, Kampfgeschwader 40 based at Bordeaux-Mérignac in 1942. The badge on the nose shows a winged bomb over Britain.



Dornier Do 217E-5 of KG 40. This aircraft is carrying two of the Henschel Hs 293A stand-off guided anti-ship missiles, which were used with some degree of success in the Mediterranean.

Specification

Dornier Do 217E-5

Type: four-seat anti-shipping bomber
Powerplant: two 1,580-hp (1178.2-kW) BMW 801C 14-cylinder air-cooled radial piston engines
Performance: maximum speed 515 km/h (320 mph) at 5200 m (17,060 ft); climb to 925 m (3,035 ft) in 4.45 minutes; service ceiling 9000 m (29,528 ft); normal range 2300 km (1,429 miles)
Weights: empty 8855 kg (19,522 lb); maximum take-off 16465 kg (36,299 lb)
Dimensions: span 19.00 m (62 ft 4 in); length 18.20 m (59 ft 8.5 in); height 5.02 m (16 ft 6 in); wing area 57.00 m² (613.54 sq ft)
Armament: one fixed 15-mm (0.59-in) gun in the nose, one 13-mm (0.51-in) gun in a dorsal turret, one 13-mm (0.51-in) gun in ventral position, and three trainable 7.92-mm (0.31-in) guns in nose and beam positions (the Do 217E-5/R19 also carried four 7.92-mm/0.31-in) guns in the extreme tail), plus an offensive load of two 1045-kg (2,304-lb) Hs 293A remotely-controlled weapons, with 295-kg (650-lb) warheads, carried under the wings

Another KG 40 Do 217 is loaded with bombs. The camouflage is typical of German maritime paint schemes, with disruptive wave patterns applied over the standard paint.

GERMANY

Heinkel He 111

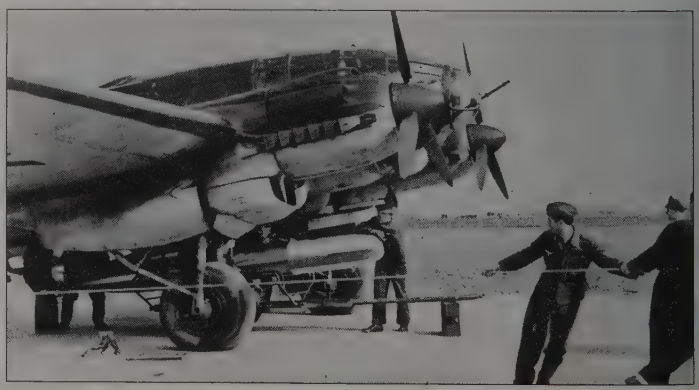
Combat experience gained by the Luftwaffe during the first 18 months of the war suggested that in anti-shipping attacks the bomb was a relatively wasteful and inaccurate weapon, except when delivered by fighter-bombers and dive-bombers, a conclusion amply borne out as the defensive armament on British ships was progressively increased. Thus it was that early in 1941 the Luftwaffe chose to place greater emphasis on the torpedo (notwithstanding considerable difficulties then being experienced in the German navy with their arming pistols) and, following trials and aircrew training at Grossenbrode in the Baltic and Grosseto in Italy, the **Heinkel He 111H-6**, carrying two 765-kg (1,687-lb) LT F5b torpedoes under the wing roots, was first delivered to I/KG 26 at Grosseto early in 1942. By June that year the whole *Geschwader* had been re-equipped and had moved to Banak and Bardufoss in northern Norway for operations against the Allied North Cape convoys. Until the inclusion of British escort carriers in these convoys, the German torpedo bombers (which also numbered some He 115 floatplanes) achieved outstanding success. Nevertheless, even when confronted by fighters over the convoy PQ.18, the He 111s of KG 26, led by Major Werner Klümper, sank eight Allied ships.

Increasingly bad weather and fighter opposition led to diminishing success in the Arctic, and in November 1942 KG 26 was redeployed to the Mediterranean. New torpedo variants were introduced, including the **He 111H-15** which featured FuG 200 anti-shipping search radar and increased gun armament. *Rüstsätz* conversion kits were also introduced to modify bomber variants to the torpedo role, but the **He 111H-12** variant, which underwent trials with two underwing Henschel Hs 293A anti-shipping weapons in conjunction with FuG 203b Kehl III guidance system, failed to achieve operational status.

Specification

Heinkel He 111H-6

Type: six-seat torpedo bomber
Powerplant: two 1,400-hp (1044-kW) Junkers Jumo 211F-1 12-cylinder liquid-cooled Vee piston engines
Performance: maximum speed 435 km/h (270 mph) at 6000 m (19,685 ft); climb to 2000 m (6,562 ft) in 8.5 minutes; service ceiling 8500 m (27,887 ft); normal range 1900 km (1,181 miles)
Weights: empty 8690 kg (19,158 lb); maximum take-off 14000 kg (30,864 lb)
Dimensions: span 22.60 m (74 ft 1.75 in); length 16.45 m (53 ft 11.5 in); height 4.00 m (13 ft 1.75 in); wing area 86.50 m² (931.07 sq ft)
Armament: six 7.92-mm (0.31-in) machine-guns in nose, dorsal, beam and ventral positions, one 20-mm cannon in the extreme nose, and (some aircraft) a remotely-fired 7.92-mm (0.31-in) gun in the extreme tail, plus an offensive load of either two 1000-kg (2,205-lb) bombs or two 765-kg (1,687-lb) LT F5b torpedoes carried on external PVC racks



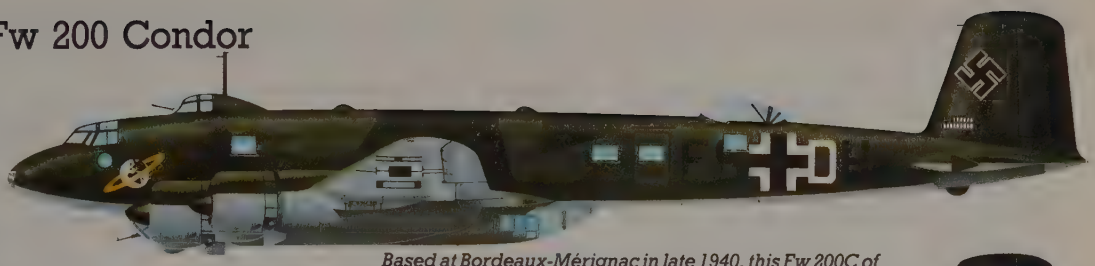
A pair of LT F5b practice torpedoes are loaded on to the underfuselage racks of a Heinkel He 111H-6. The H-6 was also used for trials with guided missiles and glide-bombs.

GERMANY

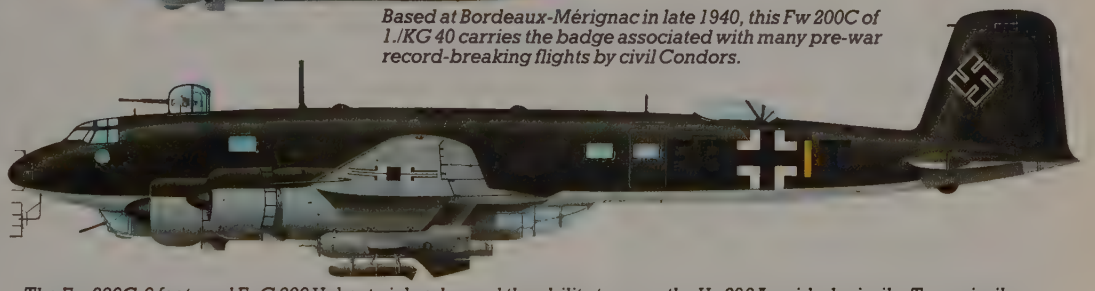
Focke-Wulf Fw 200 Condor

Famous as a pre-war airliner with a number of formidable long-distance flights and records to its credit, the four-engine **Focke-Wulf Fw 200 Condor** was dsigned by Kurt Tank in 1936, and underwent military adaptation into a fairly potent anti-shipping aircraft with the Luftwaffe. Ten pre-production **Fw-200C-0** maritime reconnaissance aircraft were delivered to the Luftwaffe in September 1939, some of them serving with I/KG 40 in 1940. The five-crew production **Fw 200C-1** was powered by four 830-hp (618.9-kW) BMW 132H engines, was armed with a 20-mm gun in the nose and three 7.92-mm (0.31-in) guns in other positions and could carry four 250-kg (551-lb) bombs. Apart from long-range maritime patrols over the Atlantic, the Fw 200C-1s also undertook extensive minelaying in British waters during 1940, each carrying two 1000-kg (2,205-lb) mines. Numerous sub-variants of the C-series appeared, of which the **Fw 200C-3** with 1,000-hp (745.7-kW) Bramo 323R-2 radials was the most important. Later in the war the **Fw 200C-6** and **Fw 200C-8** were produced in an effort to enhance the Condor's operational potential by adaptation to carry two Henschel Hs 293 missiles in conjunction with FuG 203b missile control radio.

Rugged operating conditions highlighted the Fw 200's numerous structural weaknesses and there were numerous accidents in service, and for a short time in the mid-war years Fw 20s were employed as military transports, 18 aircraft being flown by Kampfgruppe zur besonderen Verwendung 200 in support of the beleaguered German forces at Stalingrad. Other Condors were used by Hitler and Himmler as personal transports. Focke-Wulf Fw 200 production for the Luftwaffe amounted to 252 aircraft between 1940 and 1944.



Based at Bordeaux-Mérignac in late 1940, this Fw 200C of 1./KG 40 carries the badge associated with many pre-war record-breaking flights by civil Condors.



The Fw 200C-6 featured FuG 200 Hohentwiel *radar and the ability to carry the Hs 293A guided missile. Two missiles could be carried under the outboard engine nacelles.*

Specification

Focke-Wulf Fw 200C-3/U4

Type: seven-seat long-range maritime reconnaissance bomber

Powerplant: four 1,000-hp (745.7-kW) BMW-Bramo 323R-2 radial piston engines

Performance: maximum speed 360 km/h (224 mph) at 4700 m (15,420 ft); service ceiling 6000 m (19,685 ft); range 3560 km (2,211 miles)

Weights: empty 17000 kg (37,478 lb); maximum take-off 22700 kg (50,044 lb)

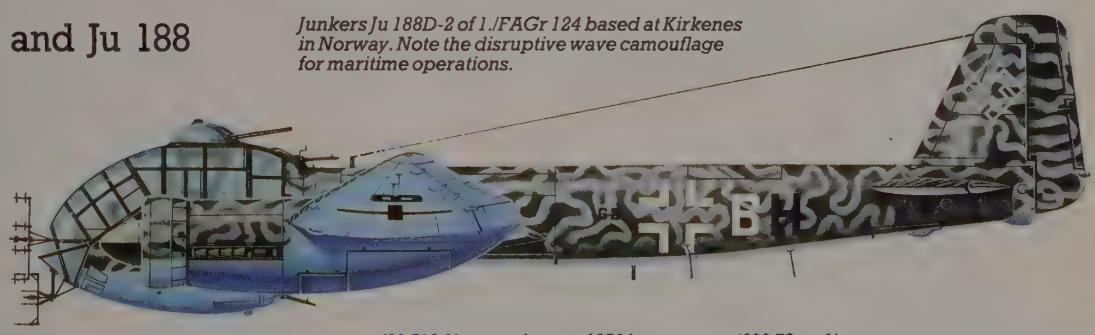
Dimensions: span 32.84 m (107 ft 9.5 in); length 23.85 m (76 ft 11.5 in); height 6.30 m (20 ft 8 in); wing area 118.00 m² (1,290.0 sq ft)

Armament: one 7.92-mm (0.31-in) gun in forward dorsal turret, one 13-mm (0.51-in) gun in rear dorsal position, two 13-mm (0.51-in) guns in beam positions, one 20-mm gun in forward position of ventral gondola and one 7.92-mm (0.31-in) gun in aft ventral position, plus a maximum bomb load of 2100 kg (4,630 lb).

GERMANY

Junkers Ju 88 and Ju 188

Junkers Ju 188D-2 of 1./FAGr 124 based at Kirkenes in Norway. Note the disruptive wave camouflage for maritime operations.



Just as the Heinkel He 111 corresponded roughly to the RAF's Vickers Wellington in the maritime role, so the **Junkers Ju 88** was a contemporary of and superficially equivalent to Coastal Command's Bristol Beaufighter. However, whereas the latter was conceived from the outset as a fighter, the Ju 88 was fundamentally a bomber which came to serve as a night-fighter and intruder.

Ju 88s flew anti-shipping missions with specialist *Kampfgeschwader*, notably KG 30, as early as the Norwegian campaign of April 1940, although the aircraft themselves were standard **Ju 88A** bombers. And it was KG 30's Ju 88s that were flown with such devastating success against British shipping during the Greek campaign of 1941. In an attack by 7./KG 30 on the approaches to Piraeus harbour Hauptmann Hajo Herrmann's bombs struck the freighter *Clan Frazer* which was loaded with explosives and blew up, destroying 10 other ships. Soon afterwards KG 30 was assembled in northern Norway for attacks against the North Cape (PQ) convoys being sailed between Iceland and Soviet ports.

Although no version of the Ju 88 was developed specifically for the anti-shipping strike role, the extensively redesigned **Junkers Ju 188**, which began making real progress before the end of 1942, appeared in several versions as a torpedo bomber. The first, the **Ju 188E-2**, could carry two 800-kg (1,764-lb) torpedoes under the wings and some aircraft also carried FuG 200 sea-search radar. This version and another, the **Ju 188A-3** with water methanol boosted engines, served in small numbers with the anti-shipping unit III/KG 26 towards the end of 1944.

The Ju 188 was a popular aircraft with its crew but, following the switch of priorities by the Germans in favour of fighters in the latter half of 1944, production of the bomber and torpedo bomber versions was halted, although they remained in fast-diminishing service until the end of the war.

Specification

Junkers Ju 188E-2

Type: four-seat torpedo bomber

Powerplant: two 1,700-hp (1267.7-kW) BMW 801D air-cooled radial piston engines

Performance: maximum speed 500 km/h (311 mph) at 6000 m (19,685 ft); climb to 6000 m (19,685 ft) in 17.6 minutes;service ceiling 9300 m (30,512 ft); normal range 1950 km (1,212 miles)

Weights: empty 9860 kg (21,737 lb); maximum take-off 14470 kg (31,898 lb)

Dimensions: span 22.00 m (72 ft 2 in); length 14.90 m (48 ft 0.5 in); height 4.44 m (14 ft 6.8 in); wing area 56.00 m² (602.78 sq ft)

Armament: gun armament (commonly) of two 13-mm (0.51-in) machine-guns in nose and dorsal positions, plus an offensive load of up to 3000 kg (6,614 lb) or two 800-kg (1,764-lb) LT lb torpedoes carried under the wings.

The superlative Ju 88 was effective in many roles, and anti-shipping was no exception. This aircraft bears 10 ship kills from the Mediterranean, denoted by the fuselage theatre band.

Attacking the North Cape Convoys

The British convoys bound for Murmansk and Archangel'sk loaded with British aid to help the Soviet war effort were a natural and inviting target for the Luftwaffe's bombers in Norway. The attacks were en masse and vicious.

The entire saga of the series of convoys which was sailed from Scotland and Iceland to Soviet northern ports from late 1941 onwards was an enterprise of incredible hardship and hazard, not only for the crews of the naval and merchant ships that constituted the convoys but also for the Luftwaffe aircrews sent out to search for, shadow and attack them. Apart from appalling weather and long hours of darkness, a ship sunk or an aircraft shot down almost invariably committed men to a rapid death in the freezing Arctic wastes, such were the long odds against rescue.

Early convoys (numbered PQ.1 onwards for those bound for Murmansk and Archangel'sk, and QP.1 onwards for those returning westwards) sailed from late in the summer of 1941 with supplies for the Soviet Union following Churchill's pledge of assistance to Stalin, and with much of the Luftwaffe's available strength committed to Operation 'Barbarossa' on the Eastern Front, these early essays encountered little in the way of enemy interference.

By March 1942, however, as significant quantities of US war supplies became available for the Soviet Union, the German air force (Luftflotte V) in northern Norway had undergone considerable strengthening, the whole of Kampfgeschwader 30 by then being based under Major Erich Blödorn with about 80 Junkers Ju 88As at Banak, the forward headquarters of the Luftwaffe. Located at Bardufoss were some 30 of the newly-developed torpedo-carrying Heinkel He 111H-6s of I/KG 26 under Hauptmann Garnot Eicke. Providing long-range reconnaissance and search were a dozen Focke-Wulf Fw 200 Condors of I/KG 40, and half that number of Blohm und Voss Bv 138 flying-boats of 2.Staffel, Küstenfliegergruppe 406. There were also about 30 short-range Junkers Ju 87B/R dive-bombers of I/StG 5. KüFlGr 406's 1.Staffel, commanded by Hauptmann Eberhard Peukert, was based at Sörreisa, near Tromsö, with 11 torpedo-carrying Heinkel He 115C-4s.

Towards the end of March 1942 the convoy PQ-13 was the first to meet with significant air attack when, after some hours of shadowing by an Fw 200, about 20 Ju 88s of III/KG 30, led by the legendary Hauptmann Hajo Herrmann, came in to attack. Hampered by patchy low cloud, the German aircrews were unable to set up co-ordinated bombing runs and only managed to hit and sink two ships with the loss of 55 lives.

A fortnight later PQ.14 set sail from Iceland, but, encountering dense fog and drifting ice floes which would have caused the convoy to reduce speed to no more than about 4 kts, the naval commander judged it prudent to turn back. PQ.15, which sailed five days later, was reported and shadowed by KüFlGr 406, and came under torpedo attack from the He 111s of KG 26, which sank three ships with the loss of nearly 80 lives.

The full might of Luftflotte V was unleashed against the next three convoys. The 34 ships which made up PQ.16 and which had sailed shortly behind PQ.15 were spotted and shadowed at long range by the Fw 200s and Bv 138s. On 25 April, and for five days after, the convoy came under repeated attack by the whole of KG 30 and I/KG 26. Realizing that in the face of such severe attacks the escort was unable to put up adequate gunfire to protect his ships, the convoy commodore ordered the

The attacks on the North Cape convoys sometimes involved aircraft flying in a line and releasing their torpedoes in a string across the path of the convoy. These Ju 88As have just released their 'fish' and will soon be looking to race through the flak to safety. It took carrierborne air power to stop these devastating attacks on the Soviet supply lines.

merchantmen to scatter and, although the Ju 87s joined in the attacks on 30 April, only seven ships were hit and sunk for the loss of 90 lives. Ten German aircraft were claimed destroyed, but these losses were not reflected in Luftwaffe records.

There followed a six-week lull in eastbound sailings, as much to allow merchantmen to return from Soviet ports as to study the best tactics in the face of the heavy German air attacks. The order to scatter had obviously saved PQ.16 from greater slaughter, but it had been acknowledged that weather conditions had been too bad to allow enemy surface ships and submarines to operate. There was now growing evidence that at least four U-boats were on patrol to the north of North Cape, while a powerful flotilla of Germany's potent destroyers were known to be based in Norway. A scattered convoy was almost defenceless against such a threat.

PQ.17 sailed from Icelandic waters on 27 June 1942, in dense fog and covered by a strong naval force which patrolled some four hours' steaming to the west. Ony three days out, the convoy was spotted by the crew of a Vaernes-based Fw 200 of 2./KG 40 and following transmission of its course and speed attacks by He 115s and U-boats developed. In attacks by eight He 115s on 2 July the leading aircraft, flown by Hauptmann Herbert Vater, was forced down by AA fire, but the crew was instantly rescued when Oberleutnant Burmester landed alongside in the treacherous seas. At dawn two days later the He 115s returned and, following a sighting by Hauptmann Eberhard Peukert, a torpedo attack severely damaged the American freighter *Christopher Newport*.

Mass attack

On 5 July the first major attack by the Ju 88s of KG 30 was launched, each column of ships being assigned to a specific *Gruppe* which then attacked in line astern of vics. In quick succession the *Peter Kerr, Washington, Bolton City, Fairfield City* and *Zaafaran* were hit by bombs and sunk. Partly as a result of this savage attack and partly owing to a series of confused signals relating to the possible approach of German surface vessels, the convoy was ordered to scatter. This time, however, the scale of German air surveillance was such that the massacre continued, five further ships being torpedoed by U-boats, while the *El Capitan* and *Hoosier* were badly damaged in air attacks by KG 30 on 10 July.

By 12 July, Luftwaffe patrols having failed to locate any of the ships of PQ.17, the Germans were convinced that the entire convoy had been wiped out, and made claims accordingly. In fact 11 surviving vessels had managed to reach the relative safety of the coast of Novaya Zemlya and in due course struggled into Soviet ports.

The loss of more than 250 merchant seamen, the ships and a considerable quantity of war matériel was an enormous setback for the Allies and one that demanded a serious reappraisal of the efforts being made to get these politically sensitive convoys through to the USSR. Despite the heavy losses thus far suffered, Stalin persisted in his complaints that his Western Allies were simply not trying their hardest to relieve the sufferings and sacrifices of the Soviet people and the sorely-pressed Red Army.

So it was that when PQ.18 sailed from Loch Ewe in Scotland on 2 September 1942 the 42 merchantmen were accompanied by an escort carrier, HMS *Avenger* with three Fairey Swordfish and 12 Hawker Sea Hurricanes of Nos 802 and 883 Squadrons embarked, six cruisers, 24 destroyers, two submarines and 13

Attacking the North Cape Convoys

The main worry of the attacking aircraft was the Sea Hurricane, which could be launched from merchant carriers (CAM-ships). As the situation in the North worsened for the Allies, an aircraft-carrier with Sea Hurricanes aboard was sent to protect the convoys. Many German aircraft suffered from the guns of these fighters.

smaller naval vessels.

After initial sightings and shadowing by German forces, submarine and air attacks on the convoy started on 12 September when a destroyer sank a U-boat. German submarines then sank two merchantmen early in the following day, but fog, rain and snow prevented attacks by the Luftwaffe until the afternoon; then, as the Sea Hurricanes were engaged in trying to destroy the shadowing Fw 200s, about 100 aircraft (including the entire available force of He 111s, each carrying a pair of torpedoes) attacked at very low level. Eight merchantmen were hit by torpedoes, and all sank.

The carrier commander then changed his orders, sending his fighters against the raiders. During 14 September the *Avenger* herself became the enemy air force's main target but, as her Sea Hurricanes shot down 12 German aircraft (confirmed in Luftwaffe records), the carrier escaped damage from several torpedo and dive-bombing attacks. Later that day further attacks by Ju 87s, Ju 88s and He 111s developed, but the cloudbase was dropping quickly and provided a measure of protection for the ships; nine more German aircraft were destroyed for the loss of three British fighters (their pilots being miraculously rescued), and a single merchantman was hit and blew up.

By 15 September PQ.18 had drawn out of range of German aircraft and as the convoy sailed on, having lost 13 ships (10 to aircraft and three to U-boats), the *Avenger* was ordered to meet and escort a homecoming convoy, which was to lose four ships before it reached home waters.

The losses sustained during the battles of these two convoys cost the Luftwaffe a total of 38 aircraft, including an Fw 200 and a Bv 138; three U-boats were also sunk. On the Allied side 17 merchant ships, with 178 lives, were lost, as were a destroyer, a minesweeper and an oiler. British aircraft losses amounted to four fighters and a flying-boat. A Sea Hurricane, catapulted from the CAM-ship *Empire Morn*, was not, however, lost; having destroyed an enemy flying-boat, the pilot managed to reach a Soviet airfield where he landed safely with 18.2 litres (4 Imp gal) of fuel remaining.

PQ.18 was the last North Cape convoy to run the gauntlet of all-out attack by the Luftwaffe; the presence and survival of the *Avenger* discouraged the German high command to the extent of withdrawing most of the bombers to other war theatres. (The *Avenger* was to be torpedoed later in 1942 during the 'Torch' landings, when she blew up with the loss of most of her crew.) The North Cape convoys nevertheless continued to sail until April 1945, and losses were suffered from time to time, mostly from attacks by U-boats. Never again, though, did the Luftwaffe attempt to mount large-scale air attacks when the raiders risked interception by carrierborne fighters.

Throughout the war at sea the Condors were active, wreaking havoc amongst Allied shipping and directing U-boats to suitable targets. At the heart of this was the Condor's excellent endurance, which had been established before the war by the German airline Lufthansa.

GERMANY

Junkers Ju 290

Fernaufklärungsgruppe (FAGr) 5 was the only operator of the Junkers Ju 290 maritime versions and used these from Mont de Marsan in France. The A-7 variant could carry up to three of the Hs 293A missiles.

Developed directly from the Ju 90 commercial and military transport, the four-engine **Junkers Ju 290** was intended to replace the Focke-Wulf Fw 200 Condor which by 1942 was proving slow and vulnerable when confronted by RAF aircraft over the 'narrow seas' around Europe. Developments of the Ju 290 nevertheless embraced considerable work to suit it for the transport role, and it was not until early 1943 that the **Ju 290A-1** underwent extensive modification as a maritime reconnaissance aircraft, including the installation of marine radio, FuG 200 Hohentwiel sea search radar and a second dorsal HDL 151 gun turret mounting an MG 151/20 cannon.

At the same time a long-range reconnaissance group, Fernaufklärungsgruppe 5, was formed and during the late summer of 1943 three of the new Ju 290A-2s were delivered to its 1.Staffel, which became operational at Mont de Marsan in France on 15 October of that year. Five **Ju 290A-3** aircraft with more powerful BMW 801D engines followed, as did five **Ju 290A-4** aircraft with improved dorsal turrets. In November a second *Staffel* was activated and, with a range of over 6100 km (3,790 miles) the Ju 290s ranged far out over the Atlantic, relaying convoy sightings to U-boats. Eleven **Ju 290A-5** aircraft with increased armour protection and 20-mm cannon in place of the earlier beam machine-guns were delivered to FAGr 5 early in 1944, as were about a dozen of the **Ju 290A-7** variant; the latter was a true anti-shipping strike aircraft capable of carrying either three Henschel Hs 293 or Fritz X weapons under fuselage and wings. It also featured a new nose section combining a nose gun position with 20-mm cannon with the FuG 200 aerial array. Only three **Ju 290A-9** aircraft were completed with reduced armament and increased fuel capacity which bestowed a maximum range of 8000 km (4,971 miles).

As the Battle of the Atlantic swung irrevocably in favour of the Allies with the loss by the Germans of French bases in August 1944, FAGr 5 was withdrawn eastwards and began operating as a transport unit, some of the Ju 290s even being flown nonstop to Manchuria carrying special supplies to the Japanese and returning with raw materials vital to Germany.

Specification

Junkers Ju 290A-5

Type: nine-seat maritime reconnaissance aircraft

Powerplant: four 1,700-hp (1267.7-kW) BMW 801D air-cooled radial piston engines

Performance: maximum speed 440 km/h (273 mph) at 6000 m (19,685 ft); climb to 1000 m (3,281 ft) in 4.2 minutes; service ceiling 6000 m (19,685 ft); maximum range 6150 km (3,822 miles)

Weights: empty about 27700 kg (61,067 lb); maximum take-off 45000 kg (99,206 lb)

Dimensions: span 42.00 m (137 ft 9.5 in); length 28.64 m (93 ft 11.5 in); height 6.83 m (22 ft 4.75 in); wing area 204.00 m² (2,195.9 sq ft)

Armament: six MG 151/20 20-mm cannon in ventral gondola, two dorsal turrets, a tail position and two beam hatches, and one 13-mm (0.51-in) machine-gun in the ventral gondola; bombs were not normally carried

ITALY

Savoia-Marchetti S.M.79

Operating in the Mediterranean in 1942, this Savoia-Marchetti S.M.79 served with the 283ª Squadriglia, 130° Gruppo Autonoma. One torpedo is carried beneath the fuselage.

Developed from an eight-seat commercial airliner of 1934, the three-engine **Savoia-Marchetti S.M.79 Sparviero** entered service as a conventional medium bomber with the Regia Aeronautica in 1937, and served operationally with the Aviacion del Tercio alongside the Nationalist forces during the Spanish Civil War. Also in 1937 the S.M.79 embarked on trials at Gorizia as a torpedo bomber, being equipped to launch a single 450-mm (17.7-in) naval torpedo from an offset rack under the fuselage. The following year trials with paired torpedoes led to the adoption of the **S.M.79-II** aircraft as standard torpedo bomber equipment. Following Italy's entry into the war in June 1940, when Sparvieri (sparrowhawks) equipped 14 *stormi* based in Italy, Sicily, Sardinia and Libya, the aircraft was constantly in action in the anti-shipping role, its first action being an attack by 19 S.M.79s of the 9° and 46° Stormi on French shipping off the Riviera coast on 13/14 June.

During the invasion of Crete S.M.79s of the 92° Gruppo and the 281ª Squadriglia were active against Allied shipping in the Aegean, after which most aircraft were redeployed to Libya for operations against British naval forces and convoys in the Central Mediterranean as well as the naval base at Malta. Among the ships of the Royal Navy sunk by S.M.79s in the Mediterranean were the destroyers HMS *Husky*, HMS *Jaguar*, HMS *Legion*, and HMS *Southwall*, while the battleship HMS *Malaya* and the carriers HMS *Indomitable* and HMS *Victorious* were all struck by torpedoes launched by the Italian torpedo bombers; the majority of these ships were hit during the attacks on the Operation 'Pedestal' convoy which sailed with 14 merchant ships and heavy escort for the relief of Malta. Among the famous Italian pilots of the Sparviero were men such as Capitani Buscaglia, Cimicchi, di Bella and Melley. An improved version was the **S.M.79-III** without the ventral gondola but with a forward-firing 20-mm cannon.

Despite the obvious value of the S.M.79 to the Axis forces in the Mediterranean, the aircraft (like so many Italian aircraft) suffered from poor servicing facilities, and it was unusual for even as much as half the available strength of Sparvieri to be fit for operations at any given time. Nevertheless the S.M.79 was acknowledged as being among the best torpedo aircraft to serve in the Mediterranean theatre during World War II.

Specification

Savoia-Marchetti S.M.79-II

Type: five-seat torpedo bomber

Powerplant: three 1,000-hp (745.7-kW) Piaggio P.XI RC 40 air-cooled radial piston engines

Performance: maximum speed 435 km/h (270 mph) at 3650 m (11,975 ft); service ceiling 7000 m (22,966 ft); normal range 2000 km (1,243 miles)

Weights: empty 7600 kg (16,755 lb); maximum take-off 11300 kg (24,912 lb)

Dimensions: span 21.20 m (69 ft 6.66 in); length 16.20 m (53 ft 1.75 in); height 4.10 m (13 ft 1.5 in); wing area 61.7 m² (664.14 sq ft)

Armament: three 12.7-mm (0.5-in) Breda-SAFAT machine-guns in two dorsal positions and one ventral position, and one 7.7-mm (0.303-in) Lewis gun on a sliding mount in the rear fuselage to provide beam defence plus two 450-mm (17.7-in) torpedoes or 1250 kg (2,756 lb) of bombs.

The S.M.79 was a fine torpedo-bomber which scored many hits against Allied shipping in the Mediterranean. It was fast for its size, and this enabled it to become one of the best Italian aircraft.

JAPAN

Mitsubishi G3M 'Nell'

As far back as 1935, in response to Japanese naval requirement for a land-based twin-engine reconnaissance aircraft, Mitsubishi flew the first **Ka-15** prototype, an aircraft which possessed a design potential that allowed development as a long-range medium bomber. Accordingly, following successful flight trials, the aircraft entered production in June 1936 as the **Navy Type 96 Attack Bomber Model 11 (Mitsubishi G3M1)**. The initial version, of which 34 were produced, was powered by 910-hp (678.6-kW) Kinsei 3 radials and possessed a maximum speed of 360 km/h (224 mph) at 1975 m (6,480 ft). As the improved Kinsei 41 and 42 engine became available in 1937 a new version, the **G3M2**, started production and, with a total of 581 built by mid-1941, was the principal variant. With a top speed now increased to 374 km/h (232 mph), a bombload of up to 800 kg (1,764 lb) carried externally and a defensive armament of three 7.7-mm (0.303-in) machine-guns, the G3M2 possessed a maximum range of 4380 km (2,722 miles). A yet further improved version, of which production was undertaken by Nakajima during 1941-3, was the **G3M3** with 1,300-hp (969.4-kW) Kinsei 51 radials and a top speed of 415 km/h (258 mph) at 6000 m (19,685 ft).

Mitsubishi G3M2s were first flown in action by the Japanese navy's Kanoya Kokutai in August 1937 in raids on Hangchow and Kwangteh in China. By 1940 four *kokutais* in China were equipped with a total of about 130 G3M2s, a number that grew to 204 by the date of Pearl Harbor with the deployment of forces against Wake Island, the Philippines and the Marianas. And it was a force of 60 G3M2s of the Genzan and Mihoro Kokutais (with 26 Mitsubishi G4M1s of the Kanoya Kokutai) which, flying from bases in Indo-China, found and sank the British warships HMS *Prince of Wales* and HMS *Repulse* as they steamed without fighter protection off the Malayan coast on 10 December 1941. The type was known to the Allies as the **'Nell'**.

Mitsubishi G3M2 of the Genzan Kokutai flying from Saigon, Indo-China, in December 1941. This aircraft participated in the sinking of HMS Prince of Wales *and* Repulse.

Specification

Mitsubishi G3M2 Model 22

Type: five/seven-seat medium/torpedo bomber

Powerplant: two 1,075-hp (801.6-kW) Mitsubishi Kinsei 45 14-cylinder air-cooled radial piston engines

Performance: maximum speed 374 km/h (232 mph) at 4200 m (13780 ft); climb to 3000 m (9,843 ft) in 8.34 minutes; service ceiling 9130 m (29,954 ft); maximum range 4380 km (2,722 miles)

Weights: empty 4965 kg (10,946 lb); maximum take-off 8010 kg (17,659 lb)

Dimensions: span 25.00 m (82 ft 0.25 in); length 16.45 m (53 ft 11.66 in); height 3.685 m (12 ft 1.1 in); wing area 75.0 m^2 (807.32 sq ft)

Armament: three 7.7-mm (0.303-in) Type 92 machine-guns in a retractable dorsal turret and two lateral blisters, and one 20-mm Type 99 cannon in a second dorsal turret, plus one 800-kg (1,764-lb) torpedo or equivalent bomb load carried externally

A formation of Mitsubishi G3Ms cross the Japanese coast during a training exercise. This aircraft was widely used, especially in the early days of the war, on all kinds of maritime operations, including torpedo dropping, bombing and patrol. Its successor, the same company's G4M, was employed alongside the G3M on similar missions.

JAPAN

Mitsubishi Ki-67 'Peggy'

Like the Ki-21 and G4M, the **Mitsubishi Ki-67** was classified by the Japanese as a heavy bomber, yet by Western standards would have scarcely rated the medium bomber category. It was nevertheless the best bomber to serve Japan in the war, albeit too late to influence the tide of events of the last year. By then the American air raids on the Japanese homeland were devastating aircraft plants and production was seriously affected. The Ki-67 Hiryu (flying dragon) was designed to a 1940 specification, issued in 1941, for a strategic bomber intended for use in an anticipated war with the Soviet Union on the Siberia-Manchukuo border. By departing from established Japanese practice and including armour protection and self-sealing fuel tanks, design of the prototype Ki-67 was protracted, and it was not until 27 December 1942 that the first aircraft flew; it proved to be highly manoeuvrable and pleasant to fly, and possessed a top speed of 538 km/h (334 mph). In the same month it was decided to adapt some Ki-67s as torpedo-bombers. The army put forward such a host of suggestions for additional equipment that production suffered long delays, and it was not until October 1944 that the Ki-67 (codenamed **'Peggy'** by the Allies) was first flown in combat by the 7th and 98th Sentais, and by the navy's 762nd Kokutai in the torpedo role during the battle off Formosa. Thereafter modifications were held to a minimum as production was afforded the highest priority; but by then American raids (and a devastating earthquake in December 1944) severely disrupted production, and no more than 698 Ki-67s were produced, some of them being flown in *kamikaze* strikes in the last months of the war.

Specification

Mitsubishi Ki-67

Type: six/eight-seat heavy bomber

Powerplant: two 1,900-hp (1416.8-kW) Mitsubishi Ha-104 radial piston engines

Performance: maximum speed 537 km/h (334 mph) at 6090 m (19,980 ft); climb to 6000 m (19,685 ft) in 14.5 minutes; service ceiling 9470 m (31,070 ft); range 2800 km (1,740 miles)

Weights: empty 8649 kg (19,068 lb); normal loaded 13765 kg (30,347 lb)

Dimensions: span 22.50 m (73 ft 9.75 in); length 18.70 m (61 ft 4.25 in); height 7.70 m (25 ft 3.2 in); wing area 65.85 m^2 (708.8 sq ft)

Proving highly manoeuvrable and fast, the Mitsubishi Ki-67 Hiryu was used in the torpedo role (especially during the Battle of Formosa). Production of this effective aircraft was severely restricted following American bombing raids and an earthquake.

Armament: single trainable 12.7-mm (0.5-in) Type 1 machine-guns in nose, two beam positions and tail, and one 20-mm Ho-5 cannon in dorsal turret, plus a bombload of 800 kg (1,764 lb) or one 1070-kg (2,359 lb) torpedo, or 2900-kg (6,393-lb) of bombs for *kamikaze* mission

British Army Part 3

The equipment used by the British army is provided largely by a home-based armaments industry comprising both public and private concerns. Largest of the public-owned suppliers are the Royal Ordnance Factories, who produce a variety of weapons ranging from artillery to ammunition. Plans are currently under way to denationalize the Royal Ordnance Factories by a public sale of shares. Some weapons, such as the 155-mm (6.1-in) FH-70, have come to the army via international development programmes, but these projects are few, and much of the equipment not produced within the United Kingdom is purchased from the United States.

Infantry weapons

The standard service rifle is the 7.62-mm (0.3-in) Rifle L1A1, an anglicized version of the Belgian FN FAL. This has been in service for nearly 30 years and is due to be replaced by a new 5.56-mm (0.219-in) Individual Weapon (IW), a bullpup design produced by the Royal Small Arms Factory at Enfield Lock. The IW will replace not only the L1A1 but the L2A3 Sterling sub-machine gun which is currently used by many second-line units and support troops such as artillery, signals and the Royal Engineers.

The standard machine-gun is the 7.62-mm (0.3-in) General-Purpose Machine-Gun, or GPMG, which may be used either on a heavy tripod or on a bipod. In both forms it uses belt-fed ammunition and fires at a cyclic rate of up to 750 rpm. Several versions exist, including some for use on armoured vehicles. The GPMG is primarily an infantry weapon and many back-up units continue to use the 7.62-mm (0.3-in) L4A4 light machine-gun, an updated version of the World War II Bren Gun. This is also scheduled for replacement by the new 5.56-mm (0.219-in) Light Support Weapon (LSW) that shares many components with the IW.

Mortars in use include the 51-mm (2.0-in) Mortar L9A1 with a maximum range of 750 m (820 yards). This is a section or platoon weapon firing HE bombs weighing just over 1 kg (2.2 lb). The main infantry support mortar is the 81-mm (3.19-in) L16A1, a very effective weapon with a maximum range of over 5650 m (6,180 yards) and firing a wide range of ammunition.

Infantry anti-tank defence is currently provided by the 84-mm (3.3-in) L14A1 'Carl Gustav' recoilless gun. This gun is now generally regarded as obsolescent and is due for replacement by the LAW 80 rocket launcher. This is understood to be capable of defeating any known tank using a 94-mm (3.7-in) rocket. The 66-mm (2.6-in) L1A1 HEAT rocket launcher is also in service but is now regarded as obsolete.

Other infantry weapons include the L2 series of hand grenades and a wide range of smoke and irritant smoke grenades. Some units carry the 9-mm (0.354-in) L9A1 Browning automatic pistol, and the American M16 5.56-mm (0.219-in) rifle is used by some specialist units. These specialist units might also make use of the L34A1 silenced version of the Sterling sub-machine gun. Snipers use the 7.62-mm (0.3-in) L42A1 rifle, a modernized version of the Lee-Enfield rifle of World War II.

Anti-tank and anti-aircraft missiles

The main long-range guided anti-tank weapon in use is the Swingfire, a powerful missile with a weight of 37 kg (81.57 lb) and a range of up to 4000 m (4,375 yards). It is carried on and fired form the FV102 Striker and the FV438 and can knock out any known tank at very long range; guidance is by wires. These tracked carriers will soon be supplemented by three battalions of FV103 Spartans, each mounting two roof-mounted Milan missiles; Milan is currently fired from a small portable launcher that is widely issued among infantry units in BAOR. It has a range of up to 2000 m (2,185 yards) and each missile weighs 6.65 kg (14.66 lb); wire guidance is used.

Forward area air defence is carried out by the Blowpipe, soon to be replaced by an updated version known as Javelin. This shoulder-launched system has a range of 3000 m (3,280 yards) but it is normally used at shorter ranges. The Javelin uses a revised guidance system. Air defence of the rear areas is provided by the Rapier, a complex air defence system that uses both visual and radar-based detection and guidance. The maximum operational height of Rapier is 3000 m (3,280 yards) and it is very accurate. Until recently most Rapiers were towed behind Land Rovers, but these are now being supplemented by Tracked Rapier which is based on a tracked chassis derived from that of the M113 armoured personnel carrier used by the US Army. Each Tracked Rapier unit is fully self-contained and uses American M548 tracked cargo carriers for replenishment.

Armour

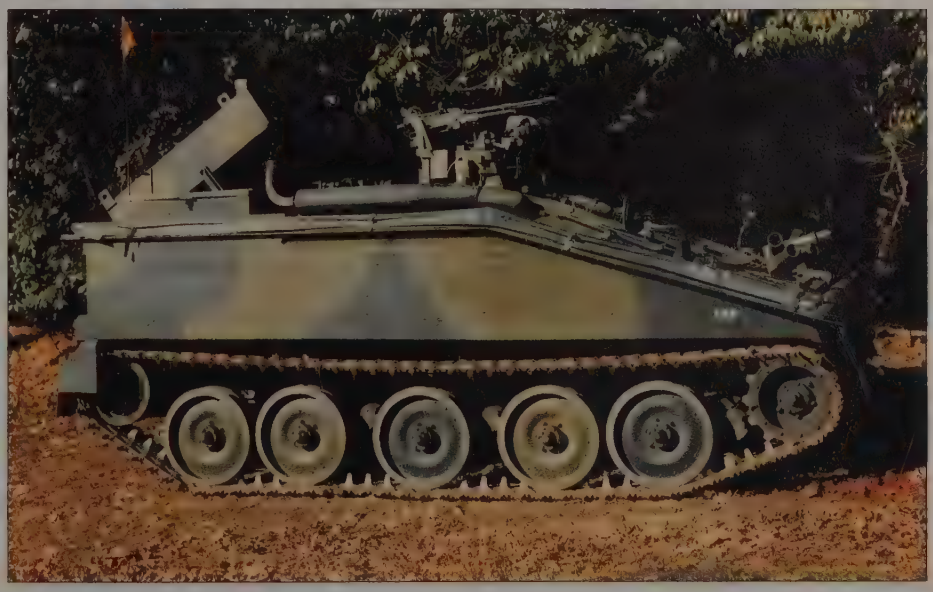
The main striking force of the Royal Armoured Corps is now provided by the FV4030/4 Challenger, now in service in BAOR and scheduled to equip five armoured regiments. This powerful tank is armed with a 120-mm (4.72-in) main gun and by the end of this decade there will be 307 in service. The Challenger is a heavy tank weighing 62 tonnes (136,686 lb) and requires some equally heavy and powerful back-up equipment such as bridging, but it is well-armoured with composite armour and uses a powerful engine providing 1,200 bhp (895 kW).

As the Challenger enters service, BAOR armoured regiments continue to rely on the FV4201 Chieftain which has been in service since 1967 but is still one of the most powerful tanks in the world. It uses the same 120-mm (4.72-in) gun now carried by Challenger but this will eventully be replaced by a new 120-mm (4.72-in) gun with an improved overall performance; this gun will also be fitted to the Challenger. Compared with the Challenger, the Chieftain is ponderous and slow but has excellent armour and a good fire-control system, and updates of all aspects will continue as the Chieftain will continue to provide the bulk of the armour in BAOR for years to come.

Reconnaissance vehicles are provided by a family of vehicles based on the FV101 Scorpion. This is a small vehicle with a three-man crew and weighing 7938 kg (17,500 lb). It mounts a 76-mm (3-in) gun in a turret while its close counterpart, the FV107 Scimitar, has a 30-mm (1.18-in) RARDEN cannon. Other vehicles in this range have box-bodied superstructures for a variety of roles, and include the FV102

The Enfield Individual Weapon is scheduled to replace both the Self-Loading Rifle and the Sterling SMG in British service. Short and handy and fitted with an optical sight as standard, it fires the excellent Belgian SS109 5.56-mm round at a cyclic rate of 650-800 rpm.

Carrying five British Aerospace Swingfire Anti-Tank Guided Missiles, the FV102 Striker is a formidable anti-tank system. The missile controller can operate the missiles by remote control from outside the vehicle, enabling them to be launched over hill crests or from behind cover.



Produced as a combined project between Britain, Germany and Italy, the FH70 155-mm gun has now replaced the old 5.5-in howitzer in British service. A new range of 155-mm ammunition has been developed for the FH70. Its basic 43.5-kg (96-lb) shell is thin-walled and has high fragmentation effect.

In June 1980 it was announced that GKN Sankey's MCV 80 won the competition to produce the new armoured personnel carrier for the British army. Armed with a 30-mm RARDEN cannon and a Hughes 7.62-mm chain gun, the MCV80 has good mobility and carries eight fully equipped infantry.

Striker mentioned above in the Swingfire role, the FV103 Spartan armoured personnel carrier (soon to carry Milan anti-tank guided missiles), the FV104 Samaritan armoured ambulance, the FV105 Sultan command post and the FV106 Samson armoured recovery vehicle. It is possible that these vehicles will be joined by an open-decked load and equipment carrier known as Streaker.

The FV721 Fox is a wheeled reconnaissance vehicle mounting a 30-mm (1.18-in) RARDEN cannon, and is used by TA yeomanry units.

The basic armoured personnel carrier is the FV432 which is little more than an armoured box on tracks. It normally carries up to 12 men including the crew, but is used in a wide variety of roles ranging from command post to ambulance and 81-mm (3.19-in) mortar carrier. Some versions use a roof-mounted turret with a 7.62-mm (0.3-in) GPMG machine-gun. The British army has a large number of these FV432s, and every unit seems to have its own particular 'fit' of equipment. Current plans are for the FV432s to be supplemented in BAOR by a new armoured personnel carrier known as MCV-80, a faster vehicle with a crew of two and up to eight soldiers. Production has yet to start, but a range of vehicles with machine-gun and cannon-armed turrets is proposed.

Another personnel carrier is the new Saxon, a wheeled armoured vehicle carrying up to 10 passengers and mainly intended for use by the 19th Infantry Brigade (a BAOR formation based in the United Kingdom). It is now entering service and several versions, including command and recovery versions, are planned. Some versions will have machine-gun turrets.

Other armour includes a variety of support vehicles including the Centurion AVRE armed with either a 165-mm (6.5-in) demolition gun or a 105-mm (4.13-in) tank gun firing High Explosive Squash Head (HESH) projectiles. These vehicles are used for combat engineering and also have dozer blades or mine ploughs plus a variety of other equipment. Also used in the combat engineering role is the Chieftain AVLB that is capable of laying assault bridges up to 24.38 m (80 ft) long. The Chieftain and Centurion chassis are also used in the armoured recovery vehicle role, but the introduction of the Challenger has required the provision of a new Chieftain variant equipped with a crane and more powerful winches known as the Chieftain ARRV (armoured repair and recovery vehicle).

Ferret scout cars are still used by a number of support units for liaison and general reconnaissance duties. Some of them continue to carry a single 0.3-in (7.62-mm) L3A3 Browning machine-gun. Other older vehicles still in use include the FV1611 Humber 'Pig' armoured personnel carrier still in use in Northern Ireland, and the FV603 Saracen, still in use for a number of specialized roles and as a command vehicle with some yeomanry units. The Shorland personnel carrier based on the Land Rover is used in Northern Ireland, while in Cyprus a small number of Saladin armoured cars are still used for patrolling.

One very specialized armoured vehicle not yet mentioned is the Combat Engineering Tractor used by the Royal Engineers. This unarmed two-man vehicle is amphibious and can be used for a range of combat engineering tasks from digging to obstacle clearance.

Although it is not armoured, mention must be made of the tracked Bx202E over-snow vehicles. These Swedish vehicles are used by units operating in Norway in a range of roles from personnel carrier to command post. They are also used to tow artillery.

Artillery

As a general rule artillery in BAOR is self-propelled, and towed artillery is used elsewhere. The most powerful artillery weapon is the nuclear Lance missile with a range of up to 121000 m (132,325 yards). It is carried on a tracked chassis derived from the American M113 armoured personnel carrier, and it is the most powerful weapon the army uses. Also in the nuclear bracket is the American 203-mm (8-in) M110A1 self-propelled howitzer that can fire a 92.53-kg (204-lb) shell to a range of 21300 m (23,294 yards).

Next in calibre downwards is the 175-mm (6.89-in) M107, another American gun that uses the same chassis as the M110A1. This is a long-range gun that fires a 66.67-kg (147-lb) shell to a range of 32700 m (35,760 yards), and is used mainly in the counter-battery role. It was intended to replace this gun by the American Multiple Launch Rocket System (MLRS), but the procurement of this long-range rocket system has now been delayed until 1988 at the earliest.

Mainstay of the BAOR artillery regiments is the 155-mm (6.1-in) M109A2, an American equipment that fires a 43-kg (94.8-lb) shell to a range of 18100 m (19,795 yards). Also in use in BAOR is the 105-mm (4.13-in) Abbot, a British gun now regarded as obsolescent as its 15.1-kg (33.29-lb) shell is now regarded as too light to break up armoured attacks. It was hoped at one time that both the Abbot and the M109A2 would be replaced by the 155-mm (6.1-in) SP-70, an international programme, but hardware for this project is still a long way in the future.

Towed artillery includes the 155-mm (6.1-in) FH-70 and the 105-mm (4.13-in) Light Gun. The FH-70 fires a 43.5-kg (95.9-lb) shell to a range of 24000 m (26,246 yards) and has its own auxiliary power unit to make short moves and to power some of the howitzers in and out of action operations. The Light Gun has proved itself to be the best in the world for rapidly-deployed forces, and was used during the Falkland Islands campaign. It fires a 15.1-kg (33.29-lb) HE shell to a range of 17200 m (18,810 yards) but weighs only 1858 kg (4,096 lb) in action.

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WAR MACHINE

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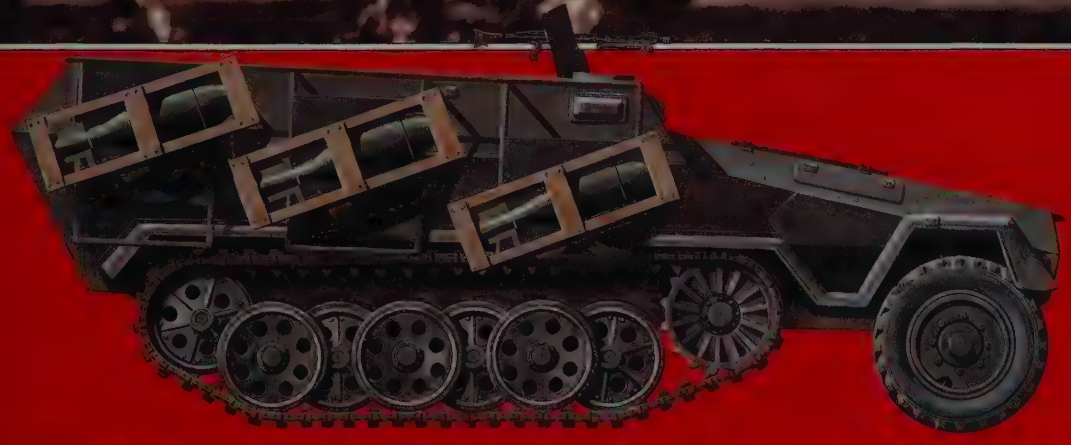

A fully illustrated guide to War Rockets of World War II

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War Rockets of World War II

Used to attack strongpoints, lay smokescreens and simply to support the fire of conventional artillery, the rockets of World War II are most famous for their use in massive bombardments on the Eastern Front. Firing them in huge numbers could more than compensate for their inaccuracy.

The most widely used rockets of World War II were the Russian 'Katyushas'. Generally mounted on trucks, they provided the Red Army with awesome firepower. Since the war they have seen widespread service in the hands of Soviet allies.

The war rocket is an old weapon that was resurrected during World War II to supplement existing attack and defence systems (artillery and anti-aircraft weapons). The rocket has much to offer the weapon designer as it is a relatively cheap and simple device that can be mass produced with comparative ease, and when used en masse is capable of fearful devastation. But in the term en masse lies the main failing of the war rocket: it has to be used in great numbers to ensure that it will hit a precise target, for the rocket is inherently a projectile that will depart from a pre-selected trajectory with alarming ease and with little apparent reason. Set against this is the fact that it can carry a powerful payload for the costs involved, and so the arguments for and against such weapons continue.

The arguments for the rocket were in the ascendancy during World War II, nearly all the major protagonists making operational use of them to some degree. Mainly it was to supplement existing weapons, but the Soviets discovered that the rocket could at times be regarded as a weapon in its own right. Technologically the Germans were the most advanced of all the World War II users, but they operated rockets as a supporting weapon to eke out artillery barrages, and only rarely attempted to deploy their rocket systems in the same offensive manner as the Red Army used its various Katyushas. The Katyushas were nearly always in the forefront of the offensive to oust the German invaders from the Soviet Union, and some of the Soviet rocket types used during those times are still in service all over the world. Indeed the Red Army has maintained the multiple rocket-launcher as an important item in its military inventory, and has improved the performance of the relevant rockets to an extraordinary degree. Only now are the Western nations beginning to relearn the importance of this weapon as a counter to massed armoured and infantry attacks.

But during World War II the rocket made a considerable impact on many ground campaigns. The German Nebelwerfer units often tipped the balance in their application of heavy barrage fire during several battles, and over the UK British rocket batteries played their part in the defence of the nation. At lower tactical levels the various American M8 weapons were often used to devastating effect in the reduction of strongpoints and bunkers. Only the Japanese failed to use the rocket to its full effect. They did make some attempts in this direction, but for them the main problem was production, not tactics.

The fire controller of the 1st Canadian rocket projector unit looks towards German positions opposite 12 Corps, 15 January 1945. The Canadian barrage is poised to begin, the rocket crewmen having made themselves scarce to avoid the fearsome backblast.

GERMANY

15-cm Wurfgranate 41

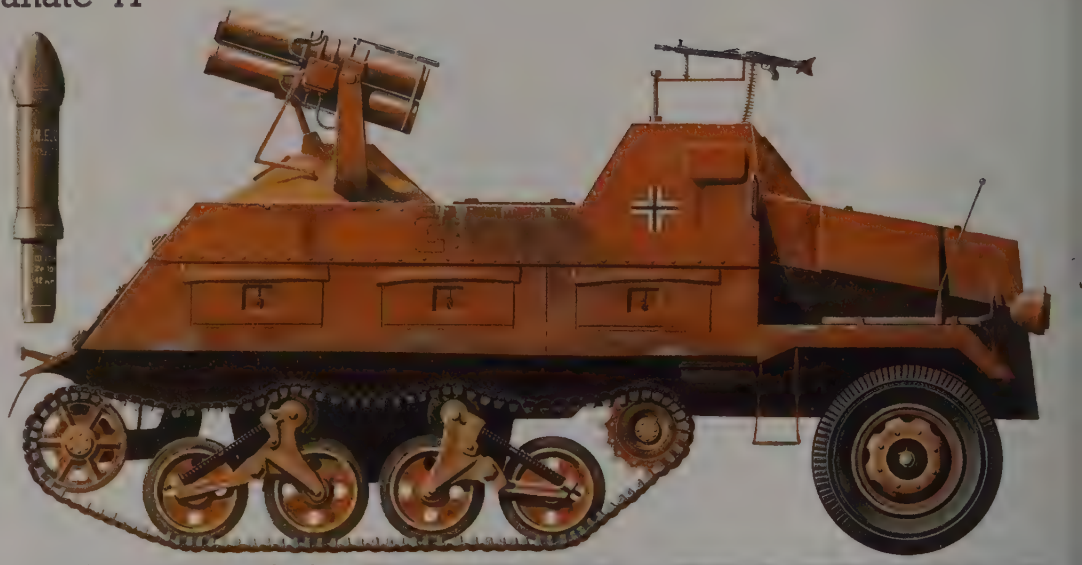
The 15-cm (5.9-in) German artillery rockets were the mainstay of the large number of German army Nebelwerfer (literally smoke-throwing) units, initially formed to produce smoke screens for various tactical uses but later diverted to use artillery rockets as well. The 15-cm (5.9-in) rockets were extensively tested by the Germans at Kummersdorf West during the late 1930s, and by 1941 the first were ready for issue to the troops

The 15-cm (5.9-in) rockets were of two main types: the **15-cm Wurfgranate 41 Spreng** (high explosive) and **15-cm Wurfgranate 41 w Kh Nebel** (smoke). In appearance both were similar and had an unusual layout, in that the rocket venturi that produced the spin stabilization were located some two-thirds of the way along the rocket body with the main payload behind them. This ensured that when the main explosive payload detonated the remains of the rocket motor added to the overall destructive effects. In flight the rocket had a distinctive droning sound that gave rise to the Allied nickname 'Moaning Minnie'. Special versions were issued for arctic and tropical use.

The first launcher issued for use with these rockets was a single-rail device known as the 'Do-Gerät' (after the leader of the German rocket teams, General Dornberger). It was apparently intended for use by airborne units, but in the event was little used. Instead the main launcher for the 15-cm (5.9-in) rockets was the **15-cm Nebelwerfer 41**. This fired six rockets from tubular launchers carried on a converted 3.7-cm Pak 35/36 anti-tank gun carriage. The tubes were arranged in a rough circle and were fired electrically one at a time in a fixed sequence. The maximum range of these rockets was variable, but usually about 6900 m (7,545 yards), and they were normally fired en masse by batteries of 12 or more launchers. When so used the effects of such a bombardment could be devastating as the rockets could cover a considerable area of target terrain and the blast of their payloads was powerful.

On the move the Nebelwerfer 41s were usually towed by light halftracks that also carried extra ammunition and other equipment, but in 1942 a halftracked launcher was issued. This was the **15-cm Panzerwerfer 42** which continued to use the 15-cm (5.9-in) rocket with the launcher tubes arranged in two horizontal rows of five on the top of an SdKfz 4/1 Maultier armoured halftrack. These vehicles were used to supply supporting fire for armoured operations. Up to 10 rockets could be carried ready for use in the launcher and a further 10 weapons inside the armoured body. Later in the war similar launchers were used on armoured schwere Wehrmachtschlepper (SWS) halftracks that were also used to tow more Nebelwerfer 41s. The SWS could carry up to 26 rockets inside its armoured hull.

The 15-cm (5.9-in) rockets were also used with the launchers intended for the 30-cm (11.8-in) rockets, with special rails for the smaller rockets fitted into the existing 30-cm (11.8-in) launcher rails.



Above: The 15-cm Panzerwerfer 42 was not only more mobile, but more survivable; rockets betrayed their position the moment they fired, so to avoid enemy artillery fire they needed to change position rapidly.

The 15-cm rockets were among the earliest in widespread use by the German army, following an extensive pre-war test programme.

Originally fired from a 6-barrel mount converted from the Pak 35/36 gun carriage, by 1942 the 10-tube launcher had been developed.

Specification
15-cm Wurfgranate 41 Spreng
Dimensions: length 979 mm (38.55 in); diameter 158 mm (6.22 in)
Weights: overall 31.8 kg (70 lb); propellant 6.35 kg (14 lb); filling 2.5 kg (5.5 lb)
Performance: initial velocity 342 m (1,120 ft) per second; range 7055 m (7,715 yards)

Specification
15-cm Wurfgranate 41 w Kh Nebel
Dimensions: length 1.02 m (40.16 in); diameter 158 mm (6.22 in)
Weights: overall 35.9 kg (79 lb); propellant 6.35 kg (14 lb); filling 3.86 kg (8.5 lb)
Performance: initial velocity 342 m (1,120 ft) per second; range 6905 m (7,550 yards)

GERMANY

21-cm Wurfgranate 42

Following on from the success of their 15-cm (5.9-in) rockets, German designers decided to produce a larger rocket which by 1941 emerged as a 210-mm (8.27-in) design. At first sight this rocket, known as the **21-cm Wurfgranate 42 Spreng**, looked exactly like a conventional artillery projectile, but closer examination showed that the base had 22 angled venturi to impart the important spin stabilization. The long streamlined nose was also deceptive, for it was hollow and the warhead proper was located some distance from the tip. This rocket contained no less than 10.17 kg (22.4 lb) of high explosive, which on detonation produced a powerful blast effect. The weapon was so successful in this destructive role that only high explosive versions were produced.

The 21-cm rocket superficially resembled a conventional artillery round, but its streamlined nose was hollow and its base had 22 angled venturi to produce spin stabilization.

The 21-cm (8.27-in) rocket was used with only one type of projector, the **21-cm Nebelwerfer 42**. The first such equipment appeared in action in the Soviet Union during 1943 as it took some time to finalize the launcher design. Originally this was to have been a simple enlargement of the existing 15-cm (5.9-in) Nebelwerfer 41 complete with six launcher tubes, but the larger calibre gave rise to some imbalance problems when the launcher was being towed and fired, so the number of tubes was eventually reduced to five and that solved the problems. In all other respects the carriage was the same as the earlier design and was a modification of the 3.7-cm (1.456-in) Pak 35/36 anti-tank gun carriage. As with the 15-cm (5.9-in) rockets the firing of the 21-cm (8.27-in) weapon was by electrical means. Once the rockets had been loaded in their tubes the launcher crew withdrew to a safe distance (or even took cover), and on receipt of the firing order one of the crew operated a special switch-gear box and the full load of rockets were fired one at a time in a fixed sequence. The salvo firing of the rockets produced a considerable amount of smoke and dust that revealed the launcher and battery position to the enemy, and during their trajectory the rockets produced their characteristic moaning noise that made them so distinctive a weapon. This combination of smoke, dust and noise meant that the Nebelwerfer troops had to be experts at getting in and out of action quickly, for any firing of the large salvoes necessary to cover a target quickly produced counterbattery artillery or rocket fire that could neutralize the launcher units.

The 21-cm (8.27-in) rockets made a considerable impression on all who had to endure their effects, and the Americans in particular considered the rocket and launcher design to be so far in advance of anything they could produce that they took some examples back to the USA and copied them. The US version was the 210-mm (8.27-in) **T36**, which was used for a series of trials and research programmes that did nothing to produce an operational weapon but which added considerably to the Americans' knowledge of artillery rocket technology

Specification
21-cm Wurfgranate 42 Spreng
Dimensions: length 1.25 m (49.21 in); body diameter 210 mm (8.27 in)
Weights: overall 109.55 kg (241.5 lb); propellant 18.27 kg (40.25 lb); explosive 10.17 kg (22.4 lb)
Performance: initial velocity 320 m (1,050 ft) per second; range about 7850 m (8,585 yards)

Entering service in 1943, the 21-cm Wurfgranate 42 was to have used the same carriage as the 15-cm rocket, but the number of tubes had to be reduced to five to compensate for the increased charge. The Americans were so impressed by the 21-cm weapon that they copied it.

GERMANY

28-cm and 32-cm Wurfkörper

The 28-cm (11-in) and 32-cm (12.6-in) rockets preceded the 15-cm (5.9-in) rockets in service with the German army, the first of them being issued for use during 1940. The two rockets shared the same rocket motor, but differed in their payload. Both were awkward and bulky rockets with a poor ballistic shape, but both had powerful payloads.

The smaller weapon was the **28-cm Wurfkörper Spreng**, which used a heavy high explosive warhead, while the larger weapon was the **32-cm Wurfkörper M Fl 50** with an incendiary warhead in heavy liquid form. Both had a range limitation of just over 2000 m (2,185 yards) and were highly inaccurate despite their spin stabilization, and were consequently used en masse whenever possible. Counterbalancing these disadvantages was the fact that both were devastating in their effects if they hit a target, and the high explosive rocket was highly regarded for use in urban fighting where houses or other structures had to be demolished.

Both rockets were issued to the troops in wooden carrying crates, or **Packkiste**. These crates doubled as launching frames and were fitted with simple forward supporting legs for rudimentary aiming purposes. In this form both rockets could be used by assault pioneers to demolish bunkers or strongpoints, but more often the rockets were used in batches of four resting on simple launcher frames known as the **schweres Wurfgerät 40** or **schweres Wurfgerät 41**, which differed from each other only in that the latter was tubular steel- rather than wooden-framed. Both could be used for pre-arranged barrages, as during the siege of Sevastopol in 1942. But this launching method was static, and to provide some form of mobility the **28/32-cm Nebelwerfer 41** was developed. This was a simple trailer with frames for six rockets in two superimposed rows of three, and after the 15-cm Nebelwerfer 41 this launcher was the most important early equipment of the Nebelwerfer units.

Another and still more mobile launcher for these rockets was the **schwerer Wurfrahmen 40**, in which six launcher frames were mounted on the sides of an SdKfz 251/1 half-track. The rockets were mounted on the side frames still in their carrying crates. Aiming was achieved by simply pointing the vehicle towards the target, and the rockets were then fired one at a time in a set sequence. This rocket/vehicle combination had several names but was often known as the 'Stuka-zu-Fuss' or 'heulende Kuh' (Foot Stuka or Howling Cow) and was often used to support Panzer operations, especially in the early days of the invasion of the Soviet Union. Later in the war other vehicles, usually captured French or other impressed vehicles, were used to bulk out the numbers of mobile launchers available. All manner of light armoured vehicles were used in this role, some carrying only four launchers. Many of these improvised launcher vehicles were used during the fighting in Normandy in 1944.

The short-ranged but powerful 28-cm and 32-cm rockets were among the first to be fitted to vehicles, in this case the ubiquitous SdKfz 251. This conversion was known as the 'Foot Stuka' or 'Howling Cow'.

Specification
28-cm Wurfkörper Spreng
Dimensions: length 1.19 m (46.85 in); body diameter 280 mm (11 in)
Weights: overall 82.2 kg (181 lb); propellant 6.6 kg (14.56 lb); filling 49.9 kg (110 lb)
Performance: range about 2138 m (2,337 yards)

Specification
32-cm Wurfkörper M Fl 50
Dimensions: length 1.289 m (50.75 in); body diameter 320 mm (12.6 in)
Weights: overall 79 kg (174 lb); propellant 6.6 kg (14.56 lb); filling 39.8 kg (87.7 lb)
Performance: range about 2028 m (2,217 yards)

Kharkov: Prelude to Stalingrad

In early 1942 the Germans were planning a massive offensive to defeat the Soviet Union before the next winter. Incredibly the Russians chose this moment to attack Kharkov where the Panzer armies were already massing for the assault.

The winter of 1941-2 shook the German army to the core. Not only was it the coldest winter for nearly 140 years, but the battles around the approaches to Moscow had led to defeat for the Germans and a shattering of the hopes and ambitions that had seemed so bright during the heady days of Operation 'Barbarossa' in the early months after June 1941. As the winter days lengthened and the snows began to melt, the Germans found themselves deep within the Soviet Union and facing the prospect of a new summer campaign.

The Red Army was in little better shape during those early days of 1942. The Moscow battles had absorbed the last of their reserves from the Far East armies, and for once the Red Army leaders faced the prospect that they were running short of men. Matériel was also in short supply. The uprooted industries that had been installed east of the Urals were hardly functioning as yet and the Red Army had to face the prospect that none could be expected to produce weapons for months to come.

Even as the last battles in the snow were grinding to a halt the staff planners on both sides were making their plans. Those of the Red Army were only too aware of the shortages ahead and intended to make one last pre-emptive strike against the German army before the summer was far enough advanced for the Germans to make their expected moves. On the German side the high-level planning, conducted by Hitler himself, was less concerned with military gains than in economics. Hitler needed the oil resources of the Caucasus region, for oil was fast becoming the weakest point of the German war economy, and without it the armed forces and industry would grind to a halt. The German army staffs were therefore given wide objectives to achieve, but for them the accent was on military success and the oil question was hardly mentioned. Instead they planned a deep strike to the east and then north. The pivot of the northward strike, which was intended to reach beyond Moscow, was a city named Stalingrad, which was at that point only an interim objective. Following behind this massive move would be a deep strike to the Caucasus.

Hitler's plan

During the early months of 1942 the German army shook itself from its winter quarters and prepared for battle. The Panzer divisions reorganized and got new tanks. Also involved in a reorganization were the Nebelwerfer brigades: by early 1942 their structure had settled down to a point where the *Abteilung* (battalion) was the main sub-unit. An *Abteilung* had a headquarters staff and battery plus two or three fire batteries. If more than one battery was equipped with 21-cm (8.27-in) projectors it was known as a heavy battalion; the usual complement, however, was two 15-cm (5.9-in) batteries and one 21-cm battery. For the long-term objectives in the Caucasus there were even a few *Gebirgswerferabteilungen* (mountain rocket projector battalions), intended for use in the mountains to the south of the Caucasus. Each of these *Abteilungen* had its own organic anti-tank defence sections.

The Nebelwerfer units were to be very active in the months ahead, for even as the Germans organized their attacking forces the Soviets were pulling together what forces they could for a pre-emptive strike. Their objective was more modest than the German aims, for all they wanted to do was recapture Kharkov, one of the major cities of the Soviet Union. In order to prepare the way and divert some of the German reserves they started their campaign with a series of offensives in the approaches to the Crimea. These duly drew off the German

In the hot days of May 1942 the crews of the Nebelwerfers toiled unceasingly, firing salvo after salvo at the Russians trapped in the Kharkov salient. For once the soaring clouds of dust and smoke produced by the rockets did not attract a hail of counterbattery fire, as most of the Red Army's artillery had already been destroyed. The barrage at Kharkov prepared the way for the victorious charge across the steppes which was to end so catastrophically at Stalingrad.

reserves, but at a high price, for the Soviet moves were all stalled by an elastic defence. In the end the Red Army withdrew from the Crimea region altogether, leaving Sevastopol to a lengthy siege. The Soviets then turned their attentions to the area near Balakleya, where the fighting of January 1942 had left a salient in the German front.

The Panzers gather

Unfortunately for the Soviets, the German army also had its eyes on the area, which was to be the launching point for the Germans' eastward advance. Behind this area, therefore, the Germans were building up, under the aegis of Army Group 'South', two primary groupings to be unveiled in July. The main force was Army Group 'B' consisting of the 2nd, 4th Panzer and 6th Armies, the last commanded by General Paulus, a name to be heard much in the year to come. Army Group 'A' had only two major German armies, the 17th and 1st Panzer, the balance of its strength being made up of a collection of satellite forces such as the Hungarians, Romanians, Italians and others. Commanded by Generalfeldmarschall List, this army group was to move south into the Caucasus with Baku as the objective for the spearhead formed by the 1st Panzer Army.

Above: Ammunition stacked ready to hand, the gunners race to reload their launchers. Once the launchers were full the crew retired to a safe distance, usually in a shelter trench, and fired the rockets electrically in pre-arranged sequence.

Kharkov: Prelude to Stalingrad

The unfortunate Red Army units were unwittingly moving right into the face of this massed array of force. Four Soviet formations (Group Bobrin and the 28th, 38th and 6th Armies of General Kostenko's South West Front) were ready to attack between Volchansk and Izyum about a week before the first German moves. Their idea was to sweep west and then south and north to cut off the German forces around Kharkov. In typical Red Army fashion their attack began on 12 May with a set-piece bombardment by artillery and massed Katyushas. The first attacks fell upon Romanian forces who promptly broke and moved to the west as fast as they could. The Soviets poured after them in hordes, horsed cavalry with T-34 tank support pursuing the hapless Romanians.

The trap is sprung

Unfortunatelay for them, the Soviets were advancing into a trap. As the Red Army tanks moved forward they were moving into a gap between two of the major forces arranging themselves for the German offensive: to their south was Gruppe Kleist (1st Panzer and 17th Armies) with all its German divisions intact and ready to move, and to the north was the 6th Army, also ready to move. As the Soviet attack moved west the German flanks held and the Red Army advance resembled a long thin pocket. Control of the Soviet forces was poor, for even as the threat to the westward advance was perceived the commanders were unable to do anything but continue the movement. Much of the Red Army's modern tank strength was committed to the attack, which simply had to work; it did not. On the morning of 17 May the German forces on the southern side of the long pocket unleashed their countermove. All along the front artillery and Nebelwerfer batteries heralded the advancing Panzers, which promptly cut across the neck of the Soviet advance and reached Izyum, the Red Army starting point. The bulk of the Soviet forces stretching to the west of Kharkov were trapped. Despite frantic efforts the Soviets were unable to move in any direction and were contained in a number of isolated battles whose only perceptible feature was a large force attempting to move north towards Kharkov while the forces to its rear broke up into small isolated groups.

It was a field day for the Nebelwerfer batteries. With the Soviet units opposite them mainly separated from their supporting artillery, the Nebelwerfer batteries were able to bombard their enemies with little risk of the usual counter-battery fire invited by the clouds of dust and dirt kicked up by their heavily-smoking rockets. Instead of the usual rush in and out of firing locations they could take their positions at an almost leisurely pace, set up their projectors, load them with their bulky rockets and take cover with less than the common haste. Once firing had started, accompanied by the usual cacophony of howling and roaring, the German crews could simply reload and prepare for the next massed salvo. To their rear the halftracks and trucks brought up more ammunition while their targets suffered and awaited the next onslaught.

The end was not far off. On 19 May Paulus nipped off the last major Red Army forces near Balakleya and the remains of the Soviet 6th, 57th and 9th Armies fled to the east, leaving all their heavy equipment behind in their rush to cross the Donets. They lost hundreds of thousands of men, all their precious tanks, and masses of artillery and Katyushas, some of which were promptly turned against the fleeing Red Army.

On to Stalingrad

It was all a prelude to the coming summer campaign. In June the major German offensive duly opened and there was nothing to stop it. The losses of the Red Army in its ill-judged Kharkov offensive had sapped the last of its reserves and supplies of tanks. Beyond the Urals the factories were working around the clock in atrocious conditions to produce more weapons to replace those losses, but trained men were in short supply. The way was thus open for the great move towards Stalingrad, the last of the Panzers' great sweeps with the dreadful battles of the winter forgotten and replaced by a victorious rush across the steppes. To the south the 1st Panzer Army swept into the Caucasus and much of the oil-producing region was lost to the Soviets.

But in less than a year it was all to change. Stalingrad, which in the winter months was no more than a dot on the map, was to sap the last energies of the German forces in the east and the initiative was to pass to a newly enlivened Red Army.

Above: A row of 28/32 cm schweres Wurfgerät H1 rocket launchers await firing. These were often emplaced in echeloned groups of four to achieve maximum saturation of the target area. Carrying a powerful payload, they had a short range of little over 2000 m (2,187 yards).

Below: With a deafening roar, the rockets blast off towards the target, leaving behind thick clouds of smoke – a clear invitation to enemy artillerymen. Fired in such a massive salvo, the rockets will completely blanket the target position in the space of a few seconds.

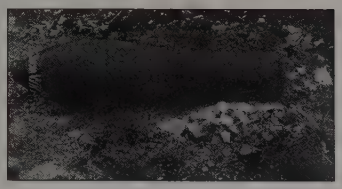
Left: A German rocket arches into the sky, kept roughly on course by its complex spin stabilization. Despite all the pressures of war, the Germans retained relatively sophisticated guidance systems, whereas the Russians relied on simple fin stabilization – and big salvoes.

GERMANY

30-cm Wurfkörper 42

Compared with 28-cm (11-in) and 32-cm (12.6-in) rockets which preceded it, the **30-cm Wurfkörper 42 Spreng** (also known as the **Wurfkörper Spreng 4491**) was a considerable improvement on the earlier designs when it appeared on the artillery scene during late 1942. Not only was it in aerodynamic terms a much smoother and cleaner design, but it had a much higher propellant/payload ratio than any other German artillery rocket. However, to the troops in the fields these technicalities were far less important than the fact that the more advanced type of propellant used with the new rocket produced far less smoke and exhaust trails than the other rockets, and was thus far less likely to give away the firing position. But for all this improvement the 30-cm (11.8-in) rocket did not have any marked range advantages over the existing rockets. It had a theoretical range of some 6000 m (6,560 yards), but practical ranges were of the order of 4550 m (4,975 yards).

The first launcher used with the new 30-cm (11.8-in) rockets was the **30-cm Nebelwerfer 42**. This was a simple conversion of the 28/32-cm Nebelwerfer 41 with the simple rail launching frames altered to accommodate the new rocket shape and size. But this simple conversion did not last long, for almost as it was issued a new programme of rationalization was drawn up and the special trailer of the Nebelwerfer 41 and 42 was eliminated. Instead a new trailer based on the carriage of the 5-cm (1.97-in) Pak 38 anti-tank gun was placed into production and the 30-cm (11.8-in) launcher frames were placed on this to produce the **30-cm Raketenwerfer 56**; to ensure that the new launcher could be used to the maximum each was provided with a set of launcher rail inserts to allow 15-cm (5.9-in) rockets to be fired if required. When not in use, these 15-cm (5.9-in) rails were stacked on top of the 30-cm (11.8-in) frames. Yet another rationalization was that the 30-cm (11.8-in) rockets could also be fired from the schwerer Wurfrahmen launcher frames of the SdKfz 251/1 half-track, originally intended for use by the 28-cm (11-in) and 32-cm (12.6-in) rockets. When launched from these frames, the 30-cm (11.8-in) rockets were fired from their carrying crates or Packkiste, and no doubt the 30-cm (11.8-in) rockets were used by assault pioneers for direct firing from their crates in the same manner as the earlier 28-cm (11-in) and 32-cm (12.6-in) weapons.



Above: The 30-cm Wurfkörper 42 rocket was an improvement over its immediate predecessors, being much cleaner aerodynamically and leaving much less telltale smoke in its wake. Despite these advantages it could not be produced in sufficient quantity to supplant the earlier designs.

Despite its relative improvements over the earlier artillery rockets, the 30-cm (11.8-in) rocket was not used in very great numbers. The earlier rockets remained in service right until the end of the war despite a late attempt to replace all existing weapons, including the 30-cm (11.8-in) type, by an entirely new 12-cm (4.72-in) spin-stabilized design. This decision was made too late in the war for anything actually to reach the troops, and it now appears doubtful if any 12-cm (4.72-in) rockets were ever made.

A gunner places some rather optimistic camouflage over a 30-cm rocket launcher. Initially fired from modified 28/32 cm launchers, the 30-cm rocket was soon provided with its own carriage, based on that of the 5-cm Pak 38 anti-tank gun.

Specification
30-cm Wurfkörper 42
Dimensions: length 1.23 m (48.44 in); body diameter 300 mm (11.8 in)
Weights: overall 125.7 kg (277 lb); propellant 15 kg (33.07 lb); explosive 44.66 kg (98.46 lb)
Performance: initial velocity 230 m (754 ft) per second; range about 4550 m (4,975 yards)

JAPAN

Japanese rockets

The Japanese recognized the value of the artillery rocket to their underarmed forces and carried out considerable design and development work in order to provide a weapon that could make up for their lack of industrial capacity. Unfortunately for them their results were patchy and well behind the work carried out by the Allies. To add to the lack of Japanese success there were often development programmes carried out in opposition to each other, and typical of these were the projects to develop a 20-cm (7.87-in) rocket by both the army and the navy.

The **Army 20-cm Rocket** may be regarded as the better of the two projects. It was a spin-stabilized rocket using six base vents to impart propulsion and spin, and had an overall resemblance to an artillery projectile. To fire this rocket the army provided what appeared to be an oversize mortar known as the **Type 4 Rocket Launcher**. The rocket was inserted into the 'barrel' by raising part of the upper section of the barrel and part of the tube base was open. This launcher was supposed to deliver the rocket relatively accurately, but few equipments appear to have been issued and most of these were used for coastal defences.

The **Navy 20-cm Rocket** resembled the army weapon in many respects, but was intended for launching from troughs made from simple wooden planks, or in some cases more sophisticated metal troughs. At times the rockets were simply emplaced to be launched directly from holes dug in the ground. A more conventional launcher used in small numbers only was a simple barrel on a light artillery-type carriage.

These 20-cm (7.87-in) rockets formed the bulk of the Japanese rocket programmes but there were others. One was the **Type 10 Rocket Motor** which was a simple propulsion unit designed to push aircraft bombs along ramps or troughs to launch them. At least two versions of the Type 10 existed but they were very inaccurate and had a maximum range of only 1830 m (2,000 yards). The launchers used for these rocket motors were often improvised, and improvisation was also used in at least one case where the conventional fins of an aircraft 250-kg (551-lb) bomb were replaced by a large rocket motor for launching from a simple wooden trough. Some intelligence reports from the period (1945) speak of these launchers mounted on trucks, but no confirmation of these has been found.

The largest of all the Japanese rockets had a diameter of 447 mm (17.6 in), and this **44.7-cm Rocket** was a somewhat crude spin-stabilized design that was used in action on Iwo Jima and Luzon. It had a range of 1958 m (2,140 yards) at best, and was launched from short wooden racks or frames. It was wildly inaccurate, but it did have a warhead weighing 180.7 kg (398 lb).

Japan undertook considerable development work on rockets, but lagged behind the other belligerent nations and produced few usable weapons. This 20-cm army rocket was one of the small number to see action.

By the time these rockets were used Japanese industrial capacity was in such a state that the conventional high explosive warheads for these rockets often had to be replaced by simple picric acid.

Specification
Army 20-cm Rocket
Dimensions: length 984 mm (38.75 in); diameter 202 mm (7.95 in)
Weights: overall 92.6 kg (44.95 lb); propellant not known; filling 16.2 kg (35.7 lb)
Performance: initial velocity not known; range not known

Specification
Navy 20-cm Rocket
Dimensions: length 1.041 m (41 in); diameter 210 mm (8.27 in)
Weights: overall 90.12 kg (198.5 lb); propellant 8.3 kg (18.3 lb); filling 17.52 kg (38.6 lb)
Performance: initial velocity not known; range 1800 m (1,970 yards)

Red Army Rocket: Katyusha

From the darkest days of 1941 to the triumphant battle for Berlin, the Katyushas bolstered the Red Army in its titanic struggle with the Wehrmacht. Since 1945 Katyushas have seen action worldwide.

For the awesome barrages which heralded a Red Army offensive rockets would be massed on static launchers close to the front. Here the first salvoes blast off against the doomed men of the German 6th Army trapped in Stalingrad, January 1943.

When the first Katyushas went into action they were rushed to the front before the Red Army was really ready for them. The initial field units used the M-13 rocket which was a much-modified and lengthened RS-132 rocket intended for aircraft use. Although the M-13 had by 1941 been developed to the point where it worked consistently on test, the production facilities needed to produce it in large numbers were only just being established, so the first rocket battery went into action with what was virtually the entire current stock of launchers and rockets.

Training for the first M-13 battery had been under way since January 1941 but had been slowed by the overall lack of equipment. The instructional staff had suddenly to start training combat crews when the Germans invaded the Soviet Union, and this new battery had only four days of tuition before it set off for the front. With the new battery went seven BM-13-16 launchers, the entire stock of M-13 rockets (about 600 in all), 44 scarce cargo trucks to carry the equipment and ammunition, and a single 122-mm (4.8-in) howitzer for ranging purposes. This battery was heavily indoctrinated with the need for secrecy regarding its novel weapons. The launchers were kept covered right until they were in action and the crews were culled mainly from dedicated party members to ensure overall security.

This first battery went into action on 7 July 1941, and was used to attack an advancing German troop concentration in a bend of the River Berezina on the Smolensk front. The sudden deluge of rocket fire caused panic among the German troops, who were the first to experience the sudden deluge of high explosive coupled with fragmentation warheads that scattered steel fragments over a wide area. The rockets all arrived on their targets in a very short space of time (measurable in seconds) and with their arrival came the scream and whine of the rockets as they fell. This sound was to make the Soviet rockets among the most feared of all weapons, and the noise was enough to demoralize even the most combat-hardened soldiers.

Following the success of its initial rocket attack the battery was in action again a few days later, this time attacking a railway junction at Orsha. Thereafter the battery was constantly in action, although at times limited by the supply of rockets, but all the time the Germans were pressing forward all along the front and by October the first rocket battery was surrounded and lost. The rocket troops destroyed their equipment before the advancing Germans could seize their prizes.

But by that time the rocket troops had made their mark. The staff officers of the Soviet 20th Army, in whose area the first battery had been operating, made very favourable reports and it was therefore decided that mass production of the M-13 and BM-13 should go ahead as soon as possible. At the time this was difficult as much of the Soviet Union's industrial capacity was either in German hands or in the process of being moved east beyond the Urals, but by September 1941 the Red Army had established a new command structure to oversee the production and employment of the new weapon. This new command used all its powers to rush the rocket weapon into the field, and Soviet war workers had to endure the most desperate privations in half-completed factories throughout the winter of 1941-2 in order to manufacture the rockets and launchers.

It was in this period that the relative simplicity of the M-13 and M-8 rocket and launcher design enabled the Soviets to churn out the required numbers. At a point early in the design and development stage of the rocket a decision had been made to produce designs with fin stabilization. These were much easier to produce than the spin-stabilized rocket designs favoured later by the Germans, and for the Soviets the decision paid off during those early days of their 'Great Patriotic War'. Rockets and launchers began to flow from the hastily-assembled factories, and by early 1942 were in the field in appreciable numbers.

The troops had at first to call their new charges Kostikov guns to hide their true nature, but the soldiers soon found their own name. The rockets and launchers became known as Katyusha (little Katy) after a popular tune of the time. The name stuck and was later used for all the various Soviet war rockets and launchers, although the official term later adopted was Guards Mortar.

In at the kill: steel shutters down, Katyushas bombard the last pocket of German resistance near the Reichstag itself in March 1945. Such was the power of the Soviet industry that by 1945 some 10,000 launchers had been produced along with over 12 million rockets.

M-13 132-mm rocket launchers in action on the outskirts of Berlin. The dreadful noise and clouds of smoke produced by rockets, combined with the shock effect of mass detonations, frequently induced panic amongst the defenders.

Original World War II Katyushas and their modern launchers are favourites of the Palestine Liberation Organization. Also, after the Israelis crushed the PLO in Beirut in 1982 they captured many Katyushas, which they now use themselves.

The M-13 rockets were soon joined by the M-8 and later by the M-30 and M-31, but these were not the only war rockets used by the Red Army during World War II. At one point during the siege of Leningrad the besieged population produced a close copy of the German 28-cm (11-in) rocket known as the M-28, but this was a local expedient only and the M-28 was little used once the siege had been lifted. Then there was the M-20 which was essentially a stretched M-13 with a much larger explosive content and double the fuel but a reduced range, and to add to this they were so long that they could be fired from the upper rails only of the BM-13 launcher. By late 1944 the M-20 had faded from the scene. There were many experimental models. A 203-mm (8-in) rocket was at one point the subject of trials that came to nothing, and at another time a 120-mm (4.72-in) rocket seemed promising but then faded from view.

But by 1945 the basic rockets in use were the M-8, M-13 (in several forms) and the M-31. After 1945 the M-8 and M-31 passed from service with the Red Army, but many were passed to friendly or occupied states and thus turned up from time to time over the troubled decade following 1945. Katyushas were used in action in Korea by the Chinese, who took to the weapon with a will. They produced Katyushas as fast as they could but it is doubtful that they managed to exceed the Soviets' output up till 1945: estimates put the latter's final total at well over 10,000 launchers and well over 12 million rockets of all kinds. At one point no less than 200 factories were producing components for the Katyushas, and Katyushas were used not only by the Red Army but also by the Soviet navy to arm light coastal and river craft. More Katyushas were mounted on armoured trains.

When the war ended the Red Army had well over 500 Katyusha batteries, and their numbers were not then reduced to any great extent. Instead they were updated and new types came into use. The Lend-Lease truck carriers were replaced by new Soviet models.

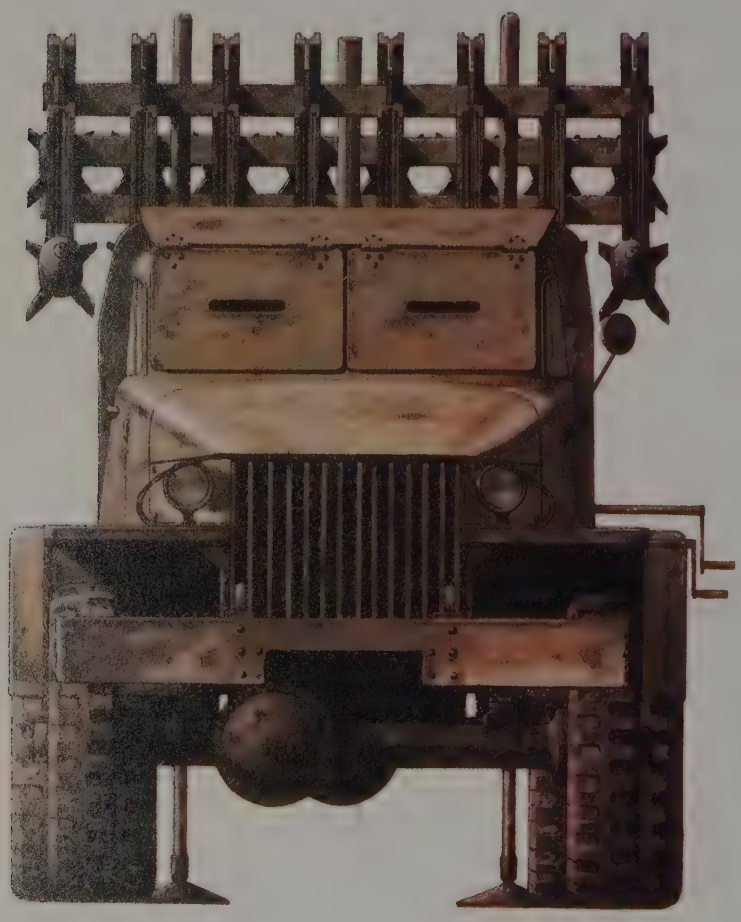
The M-13 rocket remained in service with the Red Army until the 1980s, but by then new rockets were in service. During the late 1940s and early 1950s new designs including 140-mm (5.5-in), 200-mm (7.87-in), 240-mm (9.45-in) and 250-mm (9.84-in) rockets were developed. The main change with these new designs was that with the urgency of invasion behind them the Soviet designers could divert their attentions to spin-stabilized designs. All the new rockets used such stabilization with the exception of the 250-mm (9.84-in) M-25, which has fins for at least some stability and also differed from the others in using a liquid propellant in place of the normal solid motor. The M-25 is now in very limited use, and indeed may already have passed from the military scene.

These rockets are still in service although their theatre has now generally shifted away from the Soviet Union to Soviet satellites and client states. In some cases the very type of use has altered also: originally the Katyushas were designed as artillery rockets, but with the growth of 'liberation armies' and other types of guerrilla or terrorist formations the rocket has taken on a new role. Underground movements soon learned that a Katyusha rocket of whatever calibre had an effect quite out of proportion to its size and weight when used on an individual basis against selected targets. Thus special launchers for single rockets became commonplace and are now used all over the world.

In two particular locations the sounds of single Katyusha rockets being fired against selected targets became commonplace namely in Vietnam and the border country of Israel. In Vietnam two new types of rocket were pressed into action in this role: the 122-mm (4.8-in) and 140-mm (5.5-in) weapons. The 122-mm (4.8-in) rocket was first introduced into Red Army service during the 1960s, but it was not long before a single-barrel launcher was produced specifically for guerrilla and special unit service. This rather complex launcher was frequently encountered in Vietnam, as was a much cruder launcher for the 140-mm (5.5-in) rocket. The latter was nothing more than a tube secured to a plank and placed on the ground for firing. Both launchers could be carried by a single man, with another carrying the rocket.

A similar arrangement has been encountered in the Middle East around the borders of Israel, but there the rocket involved has usually been the M-13 using a locally-produced launcher. This results from the fact that the BM-13-16 has been widely handed out by the Soviet Union to many armed forces in the area, and some of these have been passed to the Palestine Liberation Organization (PLO). From its early days as a guerrilla organization, the PLO had by the early 1980s developed to the point where it resembled a conventional army complete with BM-13s, which frequently travelled to the Israeli border to let off a salvo before retreating hurriedly, so making the border areas dangerous places to live and work. Single launchers carried by small bands added to the danger. It was these rocket attacks that often prompted Israeli raids in neighbouring territories, culminating in the invasion of Lebanon in 1982. Then the Israelis advanced right to the outskirts of Beirut where the PLO attempted to fight a conventional campaign against the Israeli army. Among the PLO's armoury were Katyushas, usually BM-13s but with some 140-mm (5.5-in) multiple launchers, firing from built-up and populated parts of Beirut to prevent the Israeli use of counterbattery fire. Despite all their efforts, the PLO was soundly beaten and forced to leave Beirut, its power base for many years. The Katyushas fell into Israeli hands, and now form part of the Israeli arsenal. So their day is not yet over, and it will be many years before their power and noise finally fade from the battlefields of the world.

Katyusha in Action



Introduced in conditions of great secrecy and crewed by dedicated party members, the first Soviet rocket launchers were tested in combat on 7 July 1941. Called Kostikov guns to conceal their real nature, they were soon nicknamed 'Katyusha' (little Katy) after a popular song of the time. Rockets were mounted on a wide variety of vehicles from obsolescent light tanks to ZiS-6 lorries, but one of the most common combinations was the M-13 132-mm rocket on American Studebaker 6×6 trucks. Note the steel shutters over the windscreen to protect the cab from the ferocious backblast.

PETER SARSON- TONY BRYAN.

USSR

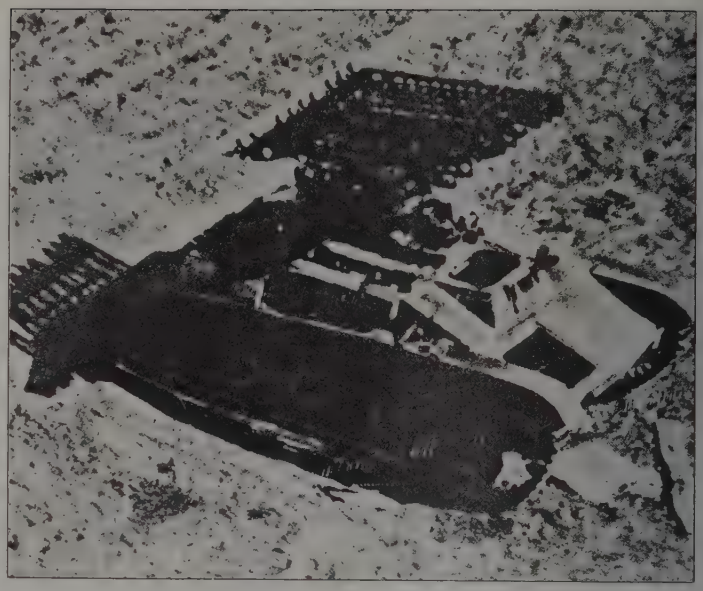
M-8 82-mm rocket

During the 1920s and 1930s the Soviet Union used a great deal of its research potential to determine exactly how propellants suitable for rockets could be mass produced. Even before 1918 the Russians had been great advocates of the war rocket, and after this the Soviets were determined to remain in the forefront of rocket technology despite the fact that they were hampered by a lack of industrial potential, which in turn led to their selection of the simpler and more easily produced fin-stabilized over the more accurate spin-stabilized rockets. One of their very first designs, produced during the late 1930s, was one of their most famous rockets, namely the 82-mm (3.23-in) **M-8**.

The M-8 rocket was an off-shoot of an aircraft rocket programme. The aircraft rocket was the RS-82, and such was the state of the Soviet rocket development programme that it actually entered service after the 132-mm (5.2-in) rocket. The M-8 was a small rocket with a maximum range of 5900 m (6,455 yards) that carried a fragmentation warhead. It was carried on and fired from a series of rails carried on 6×6 trucks, and these rail launchers were just one type of the series of weapons known as **Katyusha**. One of the first of these multiple launchers was carried on a ZiS-6 6×6 truck. As this arrangement could carry and launch up to 36 M-8 rockets it was known as the **BM-8-36**, the BM denoting 'combat vehicle' as a cover name. It was not the only vehicle that fired the M-8 rocket, for when sufficient US-supplied Lend-Lease trucks became available these too were used as M-8 launcher vehicles: typical of these was the Studebaker 6×6, which was large enough to take rails for 48 rockets and which thus became the **BM-8-48**. But being wheeled, these launchers could not always traverse the rough terrain of the Soviet Union or keep up with the tank units they were meant to support. At one point experiments were made to fit single-rail launchers to the sides of tank turrets, but they came to nothing. Instead numbers of the T-60 light tank, which had proved to be of little combat value in its designed role, were converted to take rails for 24 M-8 rockets and the type thus became known as the **BM-8-24**.

There were other launchers for the M-8 rocket, including a special eight-rocket frame intended for use by mountain troops. On all of the M-8 launchers the rockets were fired not in a massed salvo but in ripples under the control of an electrical rotary switch box.

The M-8 rockets had quite an effect on the recipient German troops who had to endure the high fragmentation warheads fired into them in large numbers. The Waffen SS was so impressed that it decided to copy the design direct (along with the launcher rails) as its own 'Himmlerorgel'. The M-8 rockets remained in service throughout the war, but following 1945 was gradually phased from use in favour of the heavier Soviet war rockets and in particular the 132-mm (5.2-in) and 310-mm (12.2-in) rockets.



Seen here mounted atop a T-70 light tank, the M-8 82-mm rocket had its origins in an aircraft rocket programme; it proved an enormous success and served throughout the war. The Waffen SS were so impressed that they copied it.

Specification
M-8
Dimensions: length 660 mm (26 in); body diameter 82 mm (3.23 in)
Weights: overall 8 kg (17.6 lb); propellant 1.2 kg (2.645 lb); explosive 0.5 kg (1.1 lb)
Performance: initial velocity 315 m (1,033 ft) per second; maximum range 5900 m (6,450 yards)

USSR

M-13 132-mm rocket

The most widely used of all the Soviet war rockets during World War II was the **M-13** 132-mm (5.2-in) weapon. It was designed during the late 1930s, and when the Germans invaded the Soviet Union in 1941 there were only a few production launchers and a small stock of rockets to hand. These were pressed into service as an emergency measure and first went into action on the Smolensk front in July 1941, when they caused near-panic among the hapless German troops. This is hardly surprising, for in a period of under 10 seconds a single M-13 battery could swamp a large area in high explosive to an extent hitherto unseen in warfare.

These first M-13 batteries were very much special units. The launchers for the M-13 fin-stabilized rockets were carried by ZiS-6 6×6 trucks with rails for 16 rockets. The rails were known as 'Flute' launchers to the Soviet troops as a result of their perforated appearance, but they soon gained the name Katyusha, and at one time were known as 'Kostikov guns' after their supposed designer. For security purposes the launchers were usually shrouded in tarpaulins when not in use, and the crews were culled from Communist party members in order to maintain tight security. But it was not long before the M-13 launchers were in widespread use and their secrets became common knowledge.

The basic M-13 rocket had a range of about 8000 to 8500 m (8,750 to 9,295 yards). The usual warhead was of the HE fragmentation type, and as always with fin-stabilized rockets accuracy was not of a high order. But as the M-13s were usually used in massed

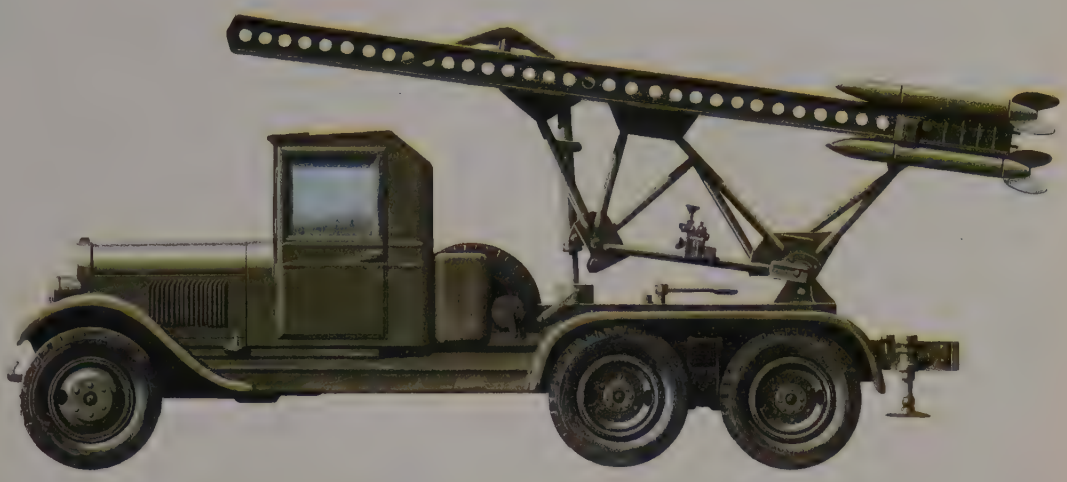
Shunted off the road and abandoned, this is the most famous of the war rockets: the truck-mounted Katyusha. Because of the distinctive moaning sound the missiles made in flight, the Germans dubbed the weapon 'Stalin's organ'.

barrages this last mattered only little. Later versions of the M-13 used a form of efflux diversion to introduce more spin for increased accuracy, but this measure reduced the range slightly. As mentioned above, the first launcher type used 16 rails and was known as the **BM-13-16**, but when supplies of Lend-Lease trucks became available they too were used as Katyusha carriers. Several types of truck, including Studebakers, Fords, Chevrolets and Internationals were so used, along with STZ-5 artillery tractors and other vehicles. These BM-13-16 launchers had no traverse and only limited elevation, and were laid by pointing the carrier vehicle towards the target. Some carrier vehicles used steel shutters to protect the cab and crew during the launching sequence.

As the war progressed more types of M-13 warhead were introduced, including armour-piercing to break up tank formations, flare for night illumination, incendiary and signal. One variation was the **M-13-DD**, which used two rocket motors burning together at launch to produce a possible range of 11800 m (12,905 yards), and this rocket was launched from the upper rails of the launcher only. The M-13-DD had the greatest range of all solid-propellant artillery rockets in World War II.

After 1945 the M-13 rocket batteries remained in Red Army use right up to 1980, when they were finally replaced by later models. The M-13 is still in service with many countries, although modern trucks are now used as carriers in place of the old war-time models. In fact the development life of the basic M-13 is still not over, for the Chinese are now using the rocket as a form of minelet-laying device known as the **Type 74**.

Specification
M-13
Dimensions: length 1.41 m (55.9 in); body diameter 132 mm (5.2 in)
Weights: overall 42.5 kg (93.7 lb); propellant 7.2 kg (15.87 lb); explosive 4.9 kg (10.8 lb)
Performance: initial velocity 355 m (1,165 ft) per second; range 8500 m (9,295 yards)



The most widely used rocket of the war, the Russian M-13 132-mm weapon came as a disagreeable surprise to German troops on the Smolensk front in July 1941. It continued to serve in the Red Army until 1980 and still equips several Russian allies today.

USSR

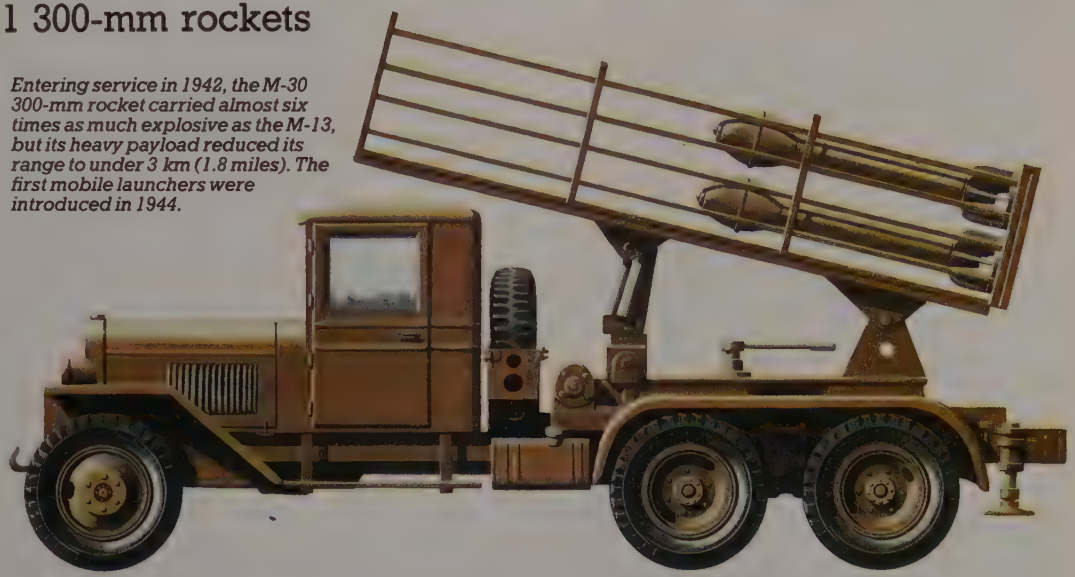
M-30 and M-31 300-mm rockets

The **M-30** 300-mm (11.8-in) rocket was introduced during 1942 when it was appreciated that good as the M-8 and M-13 rockets were, a heavier explosive warhead would be an advantage. The M-30 used a modified M-13 rocket motor allied to a bulbous warhead which contained 28.9 kg (63.7 lb) of explosive, which more than met the requirement though the range was limited to no more than 2800 m (3,060 yards). The first M-30s were fired from their carrying crates with the aid of a frame known as **Rama**, which was a close copy of the German method of using the Packkiste for launching from the schwere Wurfgerät. These Ramas were cumbersome devices that were laborious to set up close to the front line, and were little liked by the Red Army troops. But they did like the M-30 rocket for its powerful effects, even going to the extent of using the M-30 for ambushes against tanks or for house-to-house fighting. When used in this role the M-30 was simply aimed at the target while still in its carrying crate and fired at very close range.

By the end of 1942 a newer type of 300-mm (11.8-in) rocket was ready and this was known as the **M-31** to differentiate it from the earlier model. The M-31 had an improved rocket motor that gave a range of 4300 m (4,705 yards). This rocket could be fired from the Rama frames in the same manner as the M-30, but later Ramas could take six M-31s or M-30s in place of the original four. By March 1944 the first mobile launchers for the M-31 appeared. These could carry up to 12 M-31s (the short range of the M-30 ruled out their use with the mobile launchers), and the type was thus known as the **BM-31-12**. Early versions of this launcher were carried by the ZiS-6 6×6 truck, but most wartime production examples were carried on Lend-Lease Studebaker US-6 6×6 trucks. These American trucks were fitted with steel shutters over the cab windows for protection against blast when the rockets were fired.

After 1945 the M-31 rockets did not survive for many years as they were essentially short-range weapons, and as such often suffered from counterbattery fire. But the basic M-31 did undergo some developmenmt before it was dropped. There was an **M-31-UK** which used some of the efflux gases to impart a measure of spin for increased stabilization and hence accuracy. Range was slightly reduced, but the M-13-UK could greatly decrease the area of ground covered by a battery and thus increase the amount of explosive falling upon a point target.

The M-30 and M-31 rockets were fitted only with HE warheads. They were undoubtedly powerful projectiles, but they lacked range and for much of the war their mobility was virtually nonexistent as they had to be fired from the static Rama frames. It was not until the later stages of the war that they were provided with mobility in the form of the BM-31-12, a tardiness for which the German troops on the Eastern Front were no doubt grateful.



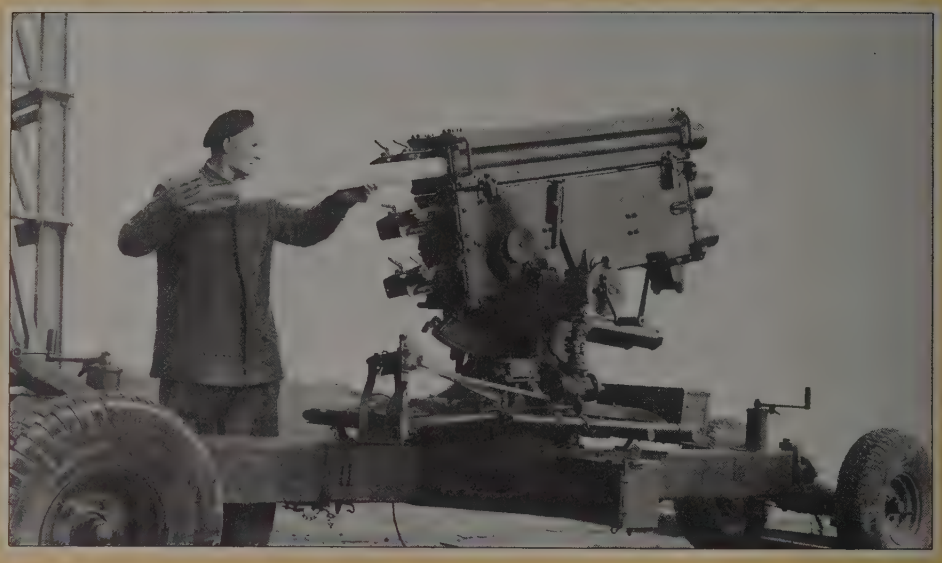
Entering service in 1942, the M-30 300-mm rocket carried almost six times as much explosive as the M-13, but its heavy payload reduced its range to under 3 km (1.8 miles). The first mobile launchers were introduced in 1944.

Specification
M-30
Dimensions: length 1.20 m (47.24 in); body diameter 300 mm (11.8 in)
Weights: overall 72 kg (158.7 lb); propellant 7.2 kg (15.87 lb); explosive 28.9 kg (63.7 lb)
Performance: initial velocity not known

Specification
M-31
Dimensions: length 1.76 m (69.3 in); body diameter 300 mm (11.8 in)
Weights: overall 91.5 kg (201.7 lb); propellant 11.2 kg (24.7 kg); explosive 28.9 kg (63.7 lb)
Performance: initial velocity 255 m (836 ft) per second

Rockets of the West

Britain had been the first Western nation to use rockets in action; Congreve rockets helped burn Washington in 1812, but the introduction of modern rockets into British Army service took a long time. But despite starting from scratch the Americans produced the best Allied rocket, the M8.



The original stimulus to British pre-war rocket design had been the need to develop an anti-aircraft weapon. Although the AA rocket proved unsuccessful it was used as the basis for some interesting designs, like this 24-pdr air-portable rocket projector.

The first nation among the Allies of World War II to devote attention to war rockets was the UK. During the 1930s the staff planners of Whitehall appreciated that the national armoury had fallen to the point at which the nation was wide open to air attack. The production of adequate numbers of anti-aircraft guns would be expensive to an extreme in the foreseen time scale (which turned out to be much shorter than expected at that time), so it was reasoned that the rocket might fill the gap to some extent.

Thus British scientists started a programme that was to last throughout the war years. Starting virtually from scratch and having only the technology derived from the old black-powder Congreve and similar designs of the previous century, they soon established some basic principles. One was that the use of new propellants based on extruded grains of cellulose-based compounds was a viable proposition, and the ability to produce such a propellant on a large scale was established. By a series of trials and errors they learned the hard way what could and could not be achieved by rockets using the new propellants, and at times the negative aspect seemed to be all too much in the ascendant.

Together with the rocket research went research into launchers. This was much simpler than that of the rocket, for the classic form of rocket launcher had been well established many decades earlier with the Congreve and Hale rockets. The rocket required only a simple frame or rail system for launching, and as mass production was the ultimate objective the simpler the design the better. That is exactly what emerged. At the time two rockets were under development consideration, namely 51-mm (2-in) and 76.2-mm (3-in) weapons, and both used very simple rail launchers. In the event the 76.2-mm rocket proved more useful and the intended anti-aircraft launcher for this was simple to an extreme. The first 76.2-mm rocket launcher, sometimes known as the Harvey projector, was simply two rails 3.658 m (144 in) in length with light metal sheets to protect the crew from blast at the moment of firing. These simple projectors were used in large batteries all placed close together and fired at the same instant, which was the only way that a target could be usefully engaged as for simplicity's sake the British rockets used fin stabilization and were thus inherently inaccurate.

The only Western weapon used in comparable numbers to the Katyusha was the American M8 4.5-in weapon, seen here in action in the Hurtgen forest, Germany, in November 1944. The gunners are re-loading, surrounded by the smoke of the last volley.

As the rockets left the launcher rails any slight influence on their path from side winds or other factors made them veer off course, sometimes to an alarming degree. Mass production methods for the rockets introduced more possible variables, and so poor was the overall performance of the first British war rockets that the only way to use them effectively was to fire vast numbers of projectiles at the target. Thus later projectors used a greater number of launcher rails until the ultimate was reached with no less than 20 rockets on a single launcher.

Once the anti-aircraft rocket was in service, it was appreciated that there could be other uses for so simple and relatively inexpensive a weapon. Various applications for the war rocket were undertaken on an experimental basis, including what was perhaps the most bizarre of all, a device known as the Grand Panjandrum. This was a massive twin-wheel arrangement propelled by rocket motors placed around the wheel rims. The idea was that the wheel could be launched from landing craft and allowed to move up a beach to any local defences, where the wheel would be exploded. The idea was sound, but it did not work in practice, despite considerable efforts. A far more successful project was the Hedgehog, which was a cross between a spigot mortar and a rocket and was used to hurl depth charges at submerged submarines. From Hedgehog grew the Hedgerow, which was used to fire racks of bombs at beach defences during the Normandy invasion. Another offshoot of the Hedgehog was the American 183-mm (7.2-in) T37 rocket.

The air threat

By the time the offshoots from the British rocket programme were under way the Americans were in the war. Starting from nothing they soon built up the entire industrial complex required for rocket production, starting with a propellant factory that was churning out extruded grains of propellants even before it was finished. The main American programme was directed towards producing an all-purpose rocket, although in the event the weapon was used mainly for the artillery role. The Americans concentrated all their efforts on the 114.3-mm (4.5-in) M8 rocket, and they made a good choice. The M8 was produced in far greater

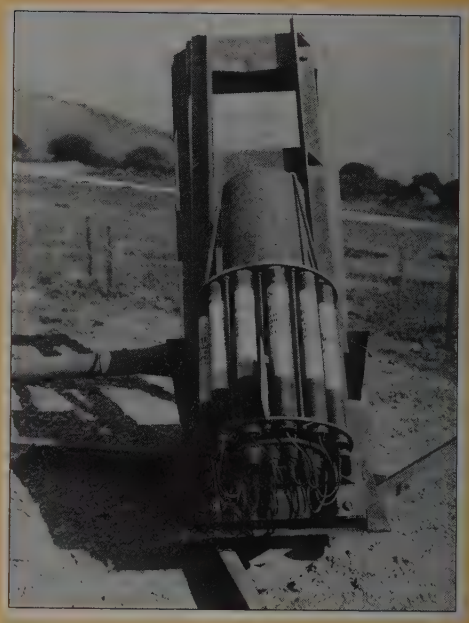
The British Land Mattress system compromised between the expense of the spin-stabilized rocket and the inaccuracy of fin-stabilized designs by using the launcher itself to impart a degree of spin to the projectile.

'Stickleback' was a British system to pulverize enemy beach defences. The projector was fixed to landing craft, and launched a hurricane of 5-in rockets, each rated as the equivalent of a 5.5-in howitzer shell. 'Stickleback' could carry up to 72 missiles.

numbers than any other solid-fuel rocket during World War II with the possible exception of the Soviet rockets, for which no precise figures are available. A bewildering array of launchers was developed to fire the M8 rocket. Few of them ever got into the hands of the troops, and the few that did were usually unable to meet the strict safety and other standards normally required by the US forces. Thus many of the M8 projectors retained their 'T' experimental designations although some were used in appreciable numbers. Some were even local or emergency improvisations such as the device known as Scorpion: this was a multiple launcher array that could be fitted into the cargo area of a DUKW amphibious cargo carrier, and could fire up to 144 M8 rockets. It was improvised to meet a local requirement during the invasion of some Japanese-held islands in the Pacific.

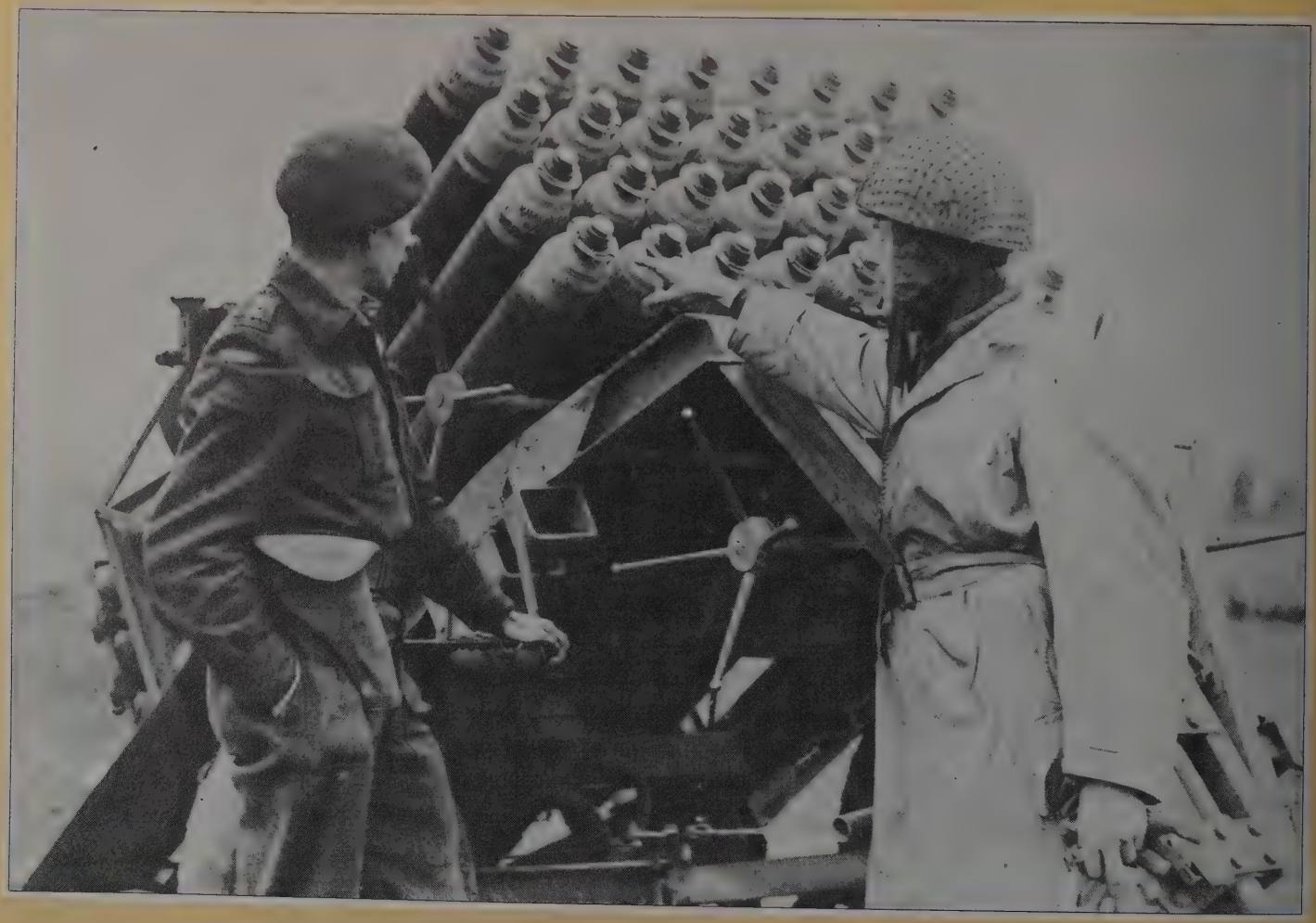
By 1944 the war rocket was already well established as an aircraft weapon, and was used to attack not only land targets but naval targets as well, including submarines. But there was one role that the Allies had yet to explore, and that was the artillery rocket. In their haste to get rockets into production both the British and the Americans plumped for the fin-stabilized rocket to speed production. But such a rocket was primarily an area-saturation weapon, a fact well demonstrated by the Soviet Katyushas, while the main protagonists of the artillery rocket were the Germans, who used spin-stabilized rockets in large numbers. Thus if the Allies wished to counter the German rocket batteries on their own terms, they too had to adopt the spin-stabilized rocket with all the attendant production costs and perhaps even some loss in potential range since this weapon has to use some of its energy to produce the spin.

In typically thorough fashion the Americans set about producing a proper spinner and in time came up with the 114.3-mm (4.5-in) M16 rocket together with its multiple projector, the T66. But producing this combination cost the Americans a great deal of time, and only small numbers saw action before the war ended. The British designers, with less production potential than the Americans, attempted a simpler way out. They used a system whereby a finned rocket was provided with a degree of spin by its launcher rails. This method, although rather crude in design terms and nowhere near as efficient as a proper spin-stabilized rocket, proved to be efficient enough for artillery use. Thus there appeared the Land Mattress, also in the later stages of the war in Europe and in insufficient numbers to make any real impression compared with the German artillery rocket batteries.



Above: Perhaps the most successful of British designs was 'Hedgehog', a rocket-propelled depth charge which enabled escorts to engage enemy submarines from all angles rather than having to drop conventional bombs from the stern. 'Hedgerow', a land version, was used in Normandy.

Below: Members of a Canadian rocket unit study their Land Mattress rocket system, a soundly designed weapon that was introduced too late and in too small numbers to make a significant impact.



USA

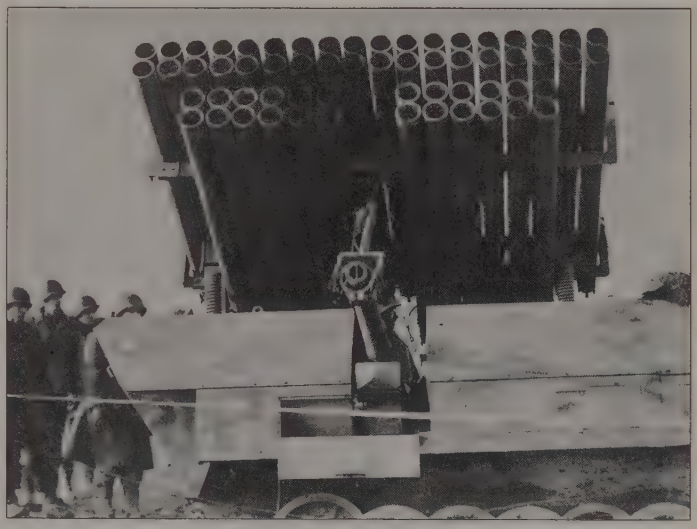
Rocket, HE, 4.5-in, M8

When the USA entered the war in 1941, the US forces had no rockets at all in service or in prospect, but with typical energy the Americans used their considerable industrial potential and technical knowledge to remedy this deficit with great speed. In what seemed like no time at all they had erected huge facilities for producing rocket propellants of all kinds and were busy designing and producing rockets for all purposes. One of these rockets was a relatively straightforward fin-stabilized weapon known initially as the **T12** but later standardized as the **Rocket, HE, 4.5-in, M8**. This nose-fused 114.3-mm (4.5-in) rocket was destined to be fabricated in larger numbers than any other World War II artillery rocket, no fewer than 2,537,000 being produced by the time the war ended. The **M8A1** and **M8A2** were slight variations of the M8 and were used in the same manner: the former had a strengthened motor body and the latter had a smaller warhead with thicker walls. The **M8A3** was an M8A2 with modified fins.

Being only fin-stabilized, the M8 was inherently inaccurate and was accordingly used not for the engagement of point targets but for the saturation of large areas with fire. Thus it was used extensively for the mass bombardment of target areas before amphibious landings or as a supplement to massed artillery bombardments. Even at short ranges its accuracy was erratic, so nearly all the launchers used with the M8 were multiple types. Typical of these was the **T27 Multiple Rocket Launcher** which fired eight M8 rockets and was carried on the back of a GMC or Studebaker 2½-ton truck. There were several variations of this launcher, one (the **T27E2**) with capacity for up to 24 rockets. The **T34** or **Calliope** was a large launcher carried over the turret of an M4 Sherman medium tank. The Calliope had no fewer than 60 launching tubes and was constructed from plywood as it was a one-shot weapon for use against strongpoints. After firing or in an emergency the whole device could be jettisoned. The **T44** was even larger than the Calliope as it had 120 launcher tubes, and was designed for installation in the cargo area of a DUKW or LVT amphibious vehicle. This was a simple area-saturation launcher as there was no method of varying elevation or traverse. A similar device known as the **Scorpion** but mounting 144 launchers was used on DUKWs in the Pacific theatre. The **T45** was a twin 14-barrel launcher that could be fitted to the sides of various vehicles, including light trucks. Yet another launcher that fired the M8 rocket was the **M12** which was a single-shot 'bunker-buster' along the lines of the British LILO.

Despite the large-scale use of the M8, its inaccuracy was such that it was considered inadequate as an artillery rocket. Using knowledge gained from trials with captured German rockets, the Americans developed a 114.3-mm (4.5-in) spin-stabilized rocket known as the **M16**, along with a multiple launcher known as the **T66** which could fire 24 rockets in two seconds. This combination arrived on the battlefronts somewhat late in the war and was used during only one engagement in Germany before the end of the war in Europe. It was not used in the Pacific theatre, but was retained on the books for some years after 1945.

When America entered the war the US Army had no rockets in service and none on the drawing board, but after a little experimentation the M8 4.5-in rocket was put into production and proved highly successful, over 2½ million being manufactured by 1945.



Right: An unusual mounting for the M8 – a captured German half-track carries the 60-tube launcher more commonly fitted to tanks. A fin-stabilized projectile, the M8 was erratic in flight and needed to be fired in quantity to guarantee a hit.

Left: M4 Sherman tanks sport the T-34 60-tube launcher known as Calliope. The tubes were made of plywood and could only be used a few times before disintegrating, but the launcher provided tank units with awesome close-range firepower.

Specification

Rocket, HE, 4.5-in, M8

Dimensions: length 838 mm (33 in); body diameter 114.3 mm (4.5 in)

Weights: overall 17.5 kg (38.5 lb); propellant 2.16 kg (4.75 lb); explosive 1.95 kg (4.3 lb)

Performance: maximum velocity 259 m (850 ft) per second; maximum range 4205 m (4,600 yards)

Above: A gunner checks the sights of the simple T-27 eight-tube launcher, generally fitted to GMC or Studebaker 2½-ton trucks. The M8 was also fired from massive 120- or even 140-round launchers fitted to DUKW amphibious vehicles for beach assault.

UK

2-in Rocket

During the late 1930s the need for improved defence of the United Kingdom against air attack was finally appreciated, but at the time it was thought that to produce enough anti-aircraft guns to meet immediate needs would take too long . Thus the rocket was investigated to see if it could provide a cheap and easily-manufactured alternative to the gun, and among the first designs investigated was a type known as the **2-in Rocket**. As things turned out the later 76.2-mm (3-in) rocket was to prove more promising, but at the time the smaller rocket seemed quite encouraging and work went ahead on the design with some momentum.

The 51-mm (2-in) rocket was a simple device that used a propellant known as solventless cordite or SCRK. The overall simplicity of the weapon could be seen in the fact that the earliest designs used a direct-action wind vane on the nose to arm the fuse after firing, with a self-destruct timer to destroy the weapon after it had been in flight for 4.5 seconds, by which time it would have reached a maximum height of about 1370 m (4,500 ft)

In the event the 51-mm (2-in) rocket was used mainly to arm light naval vessels and some merchant shipping . There were many and various simple naval mountings such as the basic vertical launchers that were mounted on each side of the bridge on many light vessels. These were supposed to launch their rockets as a low-flying aircraft attacked the ship. As the rockets rose they were designed to carry aloft a length of light wire that would enmesh itself in the aircraft's propellers and bring it down. The system never worked and neither did many other similar and somewhat optimistic devices. There was a high explosive version that could carry a 0.25-kg (0.56-lb) warhead, but by the time this was ready it was appreciated that the larger 76.2-mm (3-in) rocket was much better for this role and relatively few 51-mm (2-in) rockets were produced.

One naval mounting that was used on land was the one known as the **2-in Rocket Mounting Mk II, Pillar Box** mounting. This was used during the desperate days of 1940 and 1941 to provide at least a measure of coastal anti-aircraft defence, and could launch up to 20 rockets. The rockets were arranged in two vertical rows of five on each side of a central drum housing in which the aimer operated the simple controls. This drum housing gave the Pillar Box mounting its name. The aimer could fire all 20 of the rockets in one salvo or two salvoes of 10 rockets using electrical ignition.

Other forms of land-mounted 51-mm (2-in) rocket launchers existed and were used but only in very small numbers as temporary defensive measures. The 51-mm (2-in) rocket was really too small and light to have any great destructive effect, but the lessons learned in the design and development of these early attempts at war rockets had a good effect on later designs.

The 2-in rocket was an ingenious, if over-optimistic, anti-aircraft weapon, being designed to destroy low-flying aircraft by fouling their propellers with the long wire it left in its wake.

Specification

2-in Rocket
Dimensions: length 914.4 mm (36 in); body diameter 57 mm (2.25 in)
Weights: overall 4.88 kg (10.75 lb); warhead 0.25 kg (0.56 lb)
Performance: initial velocity 457 m (1,500 ft) per second

UK

3-in Rocket

Design work on British artillery rockets started as early as 1934, though only on a low-priority basis, and by 1937 had reached the position where a **3-in Rocket** was proposed as an alternative to the anti-aircraft gun. Under strict security conditions, development of the new rocket went ahead with the cover name **UP** (unrotated projectile). Early firings were made at Aberporth in Wales, and by 1939 the final test firings were being made in Jamaica. These led to the establishment of the first operational battery near Cardiff in South Wales, where it was known as a 'Z' battery.

This first Z battery used a single-rail launcher known as the **Projector, 3-in, Mk 1**. It was a very simple, even crude device and it was produced for both the army and the Royal Navy, although in the event most of the Royal Navy's allocation went to the merchant navy. The rocket was a simple fin-stabilized tube containing a motor and the same SCRK cordite used on the 51-mm (2-in) rocket. These early designs were somewhat erratic in performance, and accuracy was such that huge salvoes had to be fired from all the projectors in a Z battery in order to have some chance of hitting an aircraft target. They did have their successes, but they were few and not improved until the **Projector, Rocket, 3-in, No. 2 Mk 1** came along. This used a two-rail launching system and was produced in some numbers, still firing the 76.2-mm (3-in) rocket but fitted with more sophisticated fusing systems including early attempts at proximity fusing and other electro-magnetic devices. Some of these No. 2 projectors saw action in North Africa, including port defence at Tobruk.

Designed originally as an anti-aircraft system, the 3-in rocket achieved modest success as a ground weapon. However, it is better known as an air-to-ground weapon, fired from Hawker Typhoons over Normandy.

The next improvement in launching methods was the **Projector, Rocket, 3-in, No. 4 Mk 1** and **Mk 2**. This had no fewer than 36 launcher rails to fire nine rockets in a ripple sequence. This projector was mobile as it was carried on converted 76.2-mm (3-in) anti-aircraft platform trailers. Again some of these projectors were used in North Africa.

The largest of all the British 76.2-mm (3-in) rocket projectors was the **Projector, Rocket, 3-in, No. 6 Mk 1**, which could fire 20 rockets in four salvoes. This entered service in 1944 and was intended for use in static locations for

home defence. By the time they were ready many were manned by Home Guard units as they were considered simple enough for relatively untrained users, especially when they were fired en masse by battery at easily-visible targets. In the event they were little used.

One unexpected offshoot from the anti-aircraft rocket programme was that the 76.2-mm (3-in) rocket was taken up as an aircraft weapon. Fired from short launcher rails it proved to be a devastating ground attack missile, especially against tanks, and during 1944 proved to be one of the most powerful of all anti-tank weapons when used by 'cab-rank' Hawker Typhoons over the Normandy battlefields. By the time the war ended the airborne 76.2-mm (3-in) rocket had reached a considerable state of design development and was even being used to sink U-boats.

Specification
3-in Rocket
Dimensions: length 1.93 m (76 in); body diameter 82.6 mm (3.25 in)
Weights: overall 24.5 kg (54 lb); propellant 5.76 kg (12.7 lb); warhead 1.94 kg (4.28 lb)
Performance: maximum velocity 457 m (1,500 ft) per second; service ceiling 6770 m (22,200 ft); horizontal range 3720 m (4,070 yards)

UK

LILO

By 1944 the Allies were becoming accustomed to the Japanese tactic of using heavily-protected bunkers to delay Allied advances, not only on the Pacific Islands but also in the land warfare raging in South East Asia. The only effective way to demolish these formidable defensive works was by the use of heavy artillery at close ranges, but the Japanese did not always build their bunkers where such heavy weapons could get at them. The rocket was obviously a relatively portable method of dealing with such obstacles, and thus there emerged a programme known by the cover name **LILO**.

LILO was a very simple single-barrel launcher designed to fire a rocket at short range against bunker-type targets. It fired a projectile powered by the Motor, Rocket, 3-in, No. 7 Mark 1 to which two types of warhead could be fitted. Both were HE types, one weighing 17.8 kg (39.25 lb) complete and the other 35.5 kg (78.25 lb) complete. The idea was that the LILO projector could be carried to its firing location by one man, with another carrying a rocket on a suitable backpack. The projector was then set up as close to its intended target as possible and the rocket loaded into the launcher tube from the front. Open sights were used to aim the weapon, the back legs of the launcher being moved for changes in elevation. When all was ready the rocket was fired electrically, using a light 3.4-volt battery. The LILO rockets were capable of penetrating 3.05 m (10 ft) of earth plus a layer of logs, so they could normally penetrate any Japanese bunker. But the main problem was hitting the target: despite the fact that a degree of spin was imparted to the rocket as it was launched, the inherent inaccuracy of the rocket was such that to ensure a 95 per cent chance of hitting a point target distant only some 45 to 50 m (49 to 55 yards), five rockets had to be fired. This may sound uneconomic but the alternative was to bring up heavy artillery with all its attendant risks and labour.

The Americans also used a short-range rocket for the same purpose as LILO. Their device was known as the **M12 Rocket Launcher** which fired a 114.3-mm (4.5-in) rocket, and this resembled LILO in many ways apart from the fact that the first launcher tubes used were plastic and were discarded after firing. Such a system proved to be too wasteful, even for the US war economy, so a later version was developed as the **M12E1** which used a magnesium alloy tube that could be reloaded and reused. These projectors were used during the latter stages of the fighting on Okinawa when the Japanese defenders had to be blasted from their heavily-defended caves.

Specification
LILO rocket (9.53-kg/21-lb warhead)
Dimensions: length 1.238 m (48.75 in); body diameter 82.55 m (3.25 in)
Weights: overall 17.8 kg (39.25 lb); propellant 1.93 kg (4.25 lb); explosive 1.8 kg (4 lb)
Performance: not stated

Specification
LILO rocket (27.2-kg/60-lb warhead)
Dimensions: length 1.321 m (52 in); body diameter 152 mm (6 in)
Weights: overall 35.5 kg (78.25 lb); propellant 1.93 kg (4.25 lb); explosive 6.24 kg (13.75 lb)
Performance: not stated

As the Allies drove the Japanese back towards their homeland, numerous expedients were tried to knock out the toughly-constructed bunkers that were the hallmark of Japanese positions. One such was LILO – a short-range single-shot 60-lb (27-kg) rocket.

UK

Land Mattress

Although early development of the war rocket in the United Kingdom was initially to produce an anti-aircraft weapon, some consideration was also given to producing an artillery rocket. One early attempt at this was a design for a 127-mm (5-in) rocket which was rejected by the army but adopted by the Royal Navy for use in modified landing craft for the saturation of landing beaches and approaches by massed rocket fire. This eventually evolved as the **'Mattress'**, but range was limited. However, further trials revealed that the range could be improved by introducing, at launch, a degree of spin which would also improve accuracy, and this was simply achieved by using an aircraft 76.2-mm (3-in) rocket motor attached to a naval 13-kg (29-lb) warhead. This increased range to a possible 7315 m (8,000 yards), making the artillery rocket a viable proposition once more. Thus 'Mattress' became **'Land Mattress'**.

The first army launchers for these new Land Mattress rockets had 32 barrels, but a later version had 30 barrels. Demonstrations of this launcher greatly impressed Canadian army staff officers, who requested a 12-launcher battery which in the event was ready for action on 1 November 1944. This battery went into action during the crossing of the River Scheldt and was a great success, to the extent that more were requested and produced. The Land Mattress launcher was limited in its elevation capabilities to between 23 and 45°, and this not only limited the maximum range to 7225 m (7,900 yards) but also limited the minimum range to 6125 m (6,700 yards). To reduce the minimum range possible, a system of rotary spoilers over the rocket exhausts was formulated and put into use. The rotary spoiler disturbed the exhaust gases by closing off their efflux by varying amounts, and thus reducing the minimum range to 3565 m (3,900 yards).

For all the success of the Land Mattress, not many equipments were used in action before the war ended in Europe in May 1944. By that time many were only just emerging from the factories ready to be sent off to South East Asia, but their use there was very limited, as a result mainly of the weight and bulk of the projectors in the area's jungle conditions. A special 16-barrel version was accordingly developed for towing by a Jeep, but the war was over by the time it was ready for service.

In action, a single Land Mattress projector salvo could result in 50 per cent of the rockets falling in an area 215 m (235 yards) long by 219 m (240 yards) wide. The rockets were fired in ripples at 0.25-second intervals so that the entire salvo could be fired in 7.25 seconds. During the crossing of the Scheldt the first Land Mattress battery fired 1,146 rounds over a six-hour period. As each warhead payload weighed 3.18 kg (7 lb), the effects can well be imagined.

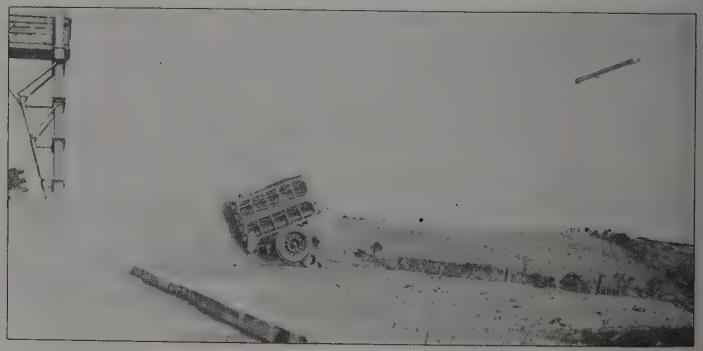
Specification

Land Mattress (rocket)
Dimensions: length 1.77 m (69.7 in)
Weights: overall 30.5 kg (67.25 lb); propellant 5 kg (11 lb); payload 3.18 kg (7 lb)
Performance: maximum velocity 335 m (1,100 ft) per second; maximum range 7225 m (7,900 yards)

Land Mattress was a curious hybrid – an army weapon constructed from an aircraft rocket motor and a 5-in naval warhead. Early models were severely restricted in performance since elevation was restricted between 23° and 45°.

Above: Loading 30.5-kg (67-lb) rockets into the 32-round launchers was an exhausting job, but to be effective rockets had to be fired in big volleys. The first Land Mattress battery fired over 1,000 rounds in six hours during the crossing of the Scheldt.

Above: Loaded and ready to fire, the crews make their final checks before taking cover. Fired at a rate of four a second, half the rockets from a 32-round projector would hit a target zone 215 m (235 yards) long and 219 m (240 yards) wide.



Right: Land Mattress spent more time on the test range than in action. After much experimentation, minimum range was reduced and a light 16-round launcher was developed for jungle warfare.

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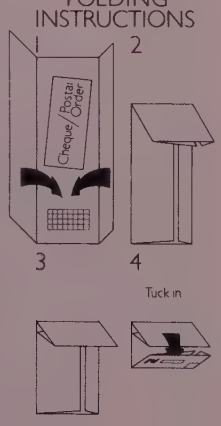

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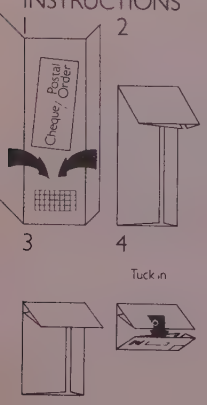

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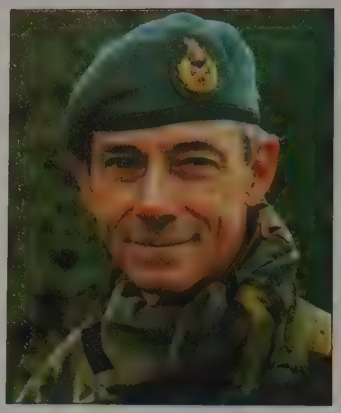

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Modern Missile Submarines

The missile control section aboard a British 'Resolution' class submarine does not look particularly dramatic, but in dozens of such places below the sea similar crews stand ready to unleash their mighty charges, hoping that they never have to put their equipment to the ultimate test.

Silently through the depths, the most menacing leviathans the world has known make their stealthy way. For months at a time the missile-carrying submarines of five nations patrol the seas, their awesome destructive power concealed and protected by the vast spaces and depths of the ocean.

The nuclear-powered ballistic missile submarine (SSBN) and the submarine-launched ballistic missile (SLBM) have become the shield of both the Eastern and Western power blocs. With vast areas of the world's oceans to roam on long lonely submerged patrols, the boats provide an almost totally immune second-strike capability against the opposing bloc's population centres and industrial targets and so keeps the possibility of a first strike well in check.

The resources required to finance, build, outfit and maintain in service such a force mean that only a handful of countries can afford to operate these vessels. The largest operator by far is the Soviet Union which, after 20 or so years, has at last outstripped the USA in terms of total force levels and capabilities, with around 62 SSBNs of six different classes in service. The Americans by contrast now field only 36 of three different classes. The Soviets also have five different missile types to the Americans' two, although the latter still lead in overall numbers of warheads carried. To back up the Americans in NATO and to provide an independent deterrent, the UK maintains one of its four Polaris-equipped SSBNs on patrol continuously, whilst France remains outside the NATO organization but still deploys one or two of her six-vessel SSBN force as part of her national strategic deterrent. In a bid to counter both major superpowers the People's Republic of China became the fifth SSBN operator recently when she deployed the first of at least four 'Xia' class SSBNs with an indigenously designed and built SLBM fitted with a thermonuclear warhead.

Because of this type of submarine's relative invulnerability to ASW countermeasures, it is expected that such boats will be around for many decades to come, although possibly in modified form as new missile types and defences evolve.

Larger than most cruisers of World War II, the current generation of ballistic missile submarines as represented by the massive USS Ohio *are without parallel in their frightening destructive might.*

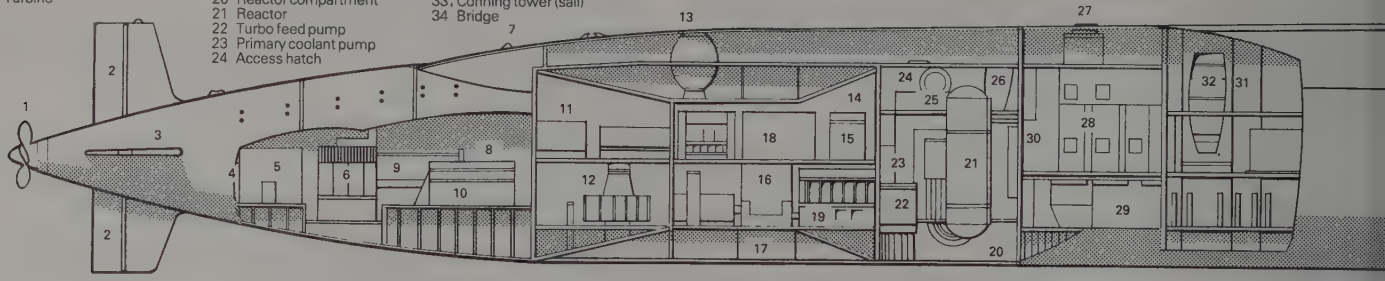
FRANCE

'Le Redoutable' class SSBN

First of the French strategic missile submarines was Le Redoutable *(S611), commissioned in December 1971.*

Le Redoutable cutaway drawing key

1 Single screw
2 Rudder
3 Hydroplane
4 Engine thrust block
5 Propulsion motor
6 Battery drive controller
7 Flagstaff holder
8 Main engine room
9 Gearbox
10 Turbine
11 Air conditioning plant
12 Main condenser
13 Aft escape hatch
14 Diesel generating room
15 Control panel
16 Turbo generator
17 Ballast
18 Motor generator
19 Motor driven feed pump
20 Reactor compartment
21 Reactor
22 Turbo feed pump
23 Primary coolant pump
24 Access hatch
25 Access door
26 Tunnel
27 Loading hatch
28 Switchboard room
29 Pump room
30 Bulkhead
31 Missile tube
32 MSBS M20 submarine-launched ballistic missile
33 Conning tower (sail)
34 Bridge
35 Surface navigation platform
36 Whip aerial
37 Diesel exhaust
38 EW (Electronic Warfare) mast
39 Snorkel
40 Radar mast
41 Periscopes
42 Directional antennae
43 Control room hatch
44 Central control position
45 Control console
46 Galley
47 Crew quarters
48 Wardroom
49 Galley
50 Sonar control
51 Junior mess hall
52 Pressure hull
53 Stores
54 Batteries
55 Battery covers
56 Forward escape hatch
57 Pump
58 Torpedo room
59 Spare torpedo
60 Torpedo tubes
61 Torpedo ports
62 Compressed air flasks
63 Access tube to conning tower



The first French SSBN (or more correctly Sous-Marin Nucléare Lance-Engine or SNLE) ***Le Redoutable*** (S611) was authorized in March 1963, laid down in November 1964 and commissioned in 1971 after being employed for 2½ years on trials as the prototype for the French naval deterrent known as the Force de Dissuasion in official circles. She and her **'Le Redoutable' class** sistership ***Le Terrible*** (S612) were initially equipped with the 2400-km (1,490-mile) range two-stage solid-propellant inertially-guided M1 SLBM that had a single 500-kiloton thermonuclear warhead and a CEP of 930 m (3,050 ft). In 1974 the third unit, ***Le Foudroyant*** (S610), was commissioned with the improved 3100-km (1,925-mile) range M2 missile with a more powerful second-stage motor but carrying the same warhead and having a similar CEP. The two previous vessels were then retrofitted with the M2 system during their normal overhauls. The fourth boat, ***L'Indomptable*** (S613), was commissioned into service in 1977 with the vastly improved M20 missile that has the same range and accuracy as the M2 but carries a new 1.2-megaton yield specially hardened warhead with what is believed to be chaff dispensing penetration aids to confuse defending radar systems. The last vessel, ***Le Tonnant*** (S614), was also completed with the M20 whilst the three units equipped with the M2 have now been brought up to the same standard. From 1985 the last four units built will undergo yet another modification to carry the M4 SLBM that is due to enter service in January of that year aboard *L'Inflexible*. All five boats are to be converted to carry the underwater-launched SM.39 Exocet anti-ship missile and the sonars of *L'Inflexible*. The planned deletion dates for the class are S611 1997, S612 1999, S610 2002, S613 2004 and S614 2008.

Le Foudroyant ***(S610) and her sister-ships were designed and built in France without any help from the Americans, unlike the British Polaris boats, which required considerable design assistance.***

FRANCE

'L'Inflexible' class SSBN

Ordered in September 1978, the sole **'L'Inflexible' class** boat ***L'Inflexible*** (S615) is to be an intermediate design between the 'Le Redoutable' class and a new class of 14,000-15,000 tons planned to be operational around 1993-4. She will retain most of the external characteristics of the earlier class, but the internal fittings and sensors will differ by taking advantage of the advances made in the propulsion system, electronics and weapons since the 'Le Redoutable' class boats were constructed. The rationale behind this intermediate boat lies in the fact that France requires three SSBNs to be continuously available, of which two are to be on patrol. In order to achieve this the French navy has to have six submarines in service, a number one more than the 'Le Redoutable' class total.

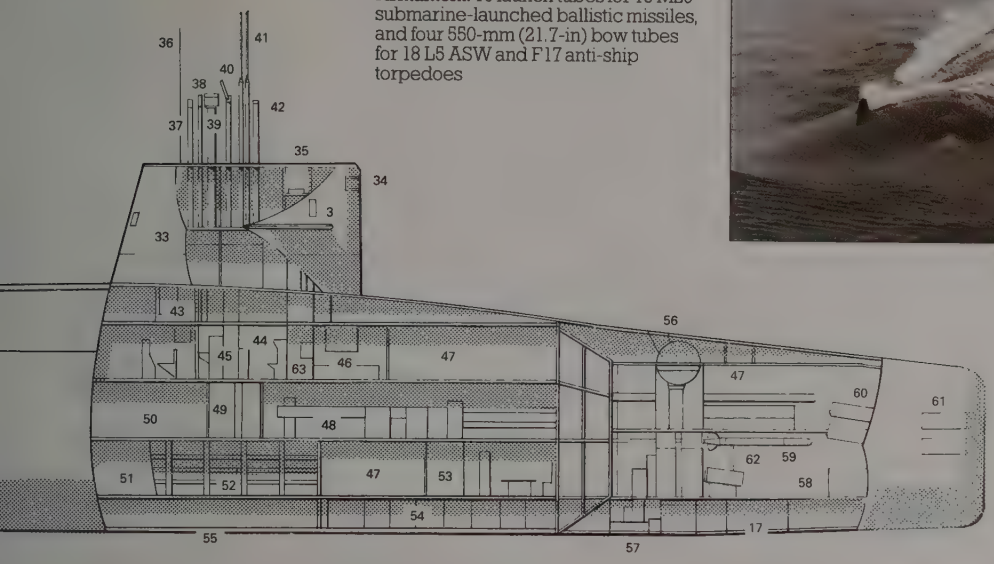
Laid down in March 1980, *L'Inflexible* will achieve operational status in January 1985 and is not due for deletion until 2012. Like all French missile submarines, she will have two crews, Bleu (blue) and Ambre (amber), to crew the vessel in rotation in order to maximize the time spent on patrol between reactor-refuelling refits. French SSBNs normally undertake patrols of two months' duration, with three months as the absolute maximum. All the vessels are based at Ile Longue near Brest and have special protection when transiting to and from the port. This includes the French navy's sole Aérospatiale SA 321G Super Frelon ASW helicopter unit, Flottille 32F, which operates in groups of up to four helicopters to screen the boats, one helicopter dunking its sonar whilst the others stand back ready to attack if required.

Specification

'L'Inflexible' class
Displacement: 8,080 tons surfaced and 8,920 tons dived
Dimensions: length 128.7 m (422.2 ft); beam 10.6 m (34.8 ft); draught 10.0 m (32.8 ft)
Propulsion: one pressurized water-cooled reactor powering two steam turbines driving one shaft
Speed: 18 kts surfaced and 25 kts dived
Diving depth: 350 m (1,150 ft) operational and 465 m (1,525 ft) maximum
Armament: 16 launch tubes for 16 M4 submarine-launched ballistic missiles, and four 533-mm (21-in) bow tubes for 14 L5 ASW and F17 anti-ship torpedoes plus four SM.39 Exocet anti-ship missiles
Electronics: one surface-search radar, one passive ESM system, one DLT D3 torpedo and Exocet fire-control system, one DSUX 21 sonar, and one DUUX 5 underwater telephone
Complement: 135

Specification
'Le Redoutable' class
Displacement: 8,045 tons surfaced and 8,940 tons dived
Dimensions: length 128.7 m (422.2 ft); beam 10.6 m (34.8 ft); draught 10.0 m (32.8 ft)

Propulsion: one pressurized water-cooled reactor powering two steam turbines driving one shaft
Speed: 18 kts surfaced and 25 kts dived
Diving depth: 250 m (820 ft) operational and 330 m (1,085 ft) maximum
Armament: 16 launch tubes for 16 M20 submarine-launched ballistic missiles, and four 550-mm (21.7-in) bow tubes for 18 L5 ASW and F17 anti-ship torpedoes



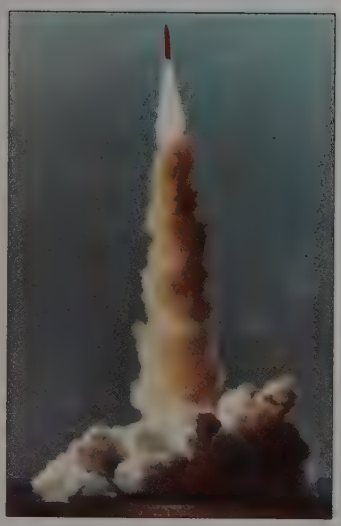
Above: The French try to maintain a minimum of two SNLEs on patrol at any one time, with submarines such as* Le Terrible *(S612) being screened on departure and return by French navy surface units, submarines and ASW aircraft in order to maintain security.

Electronics: one Calypso surface-search radar, one DLT D3 torpedo fire-control system, one passive ESM system, one DSUV 23 sonar, and one DUUX 2 underwater telephone
Complement: 135

FRANCE

M20 SLBM

The **Mer-Sol Balistique Stratégique M20** is essentially a variant of the earlier two-stage M2 with the Rita 11/P6 second stage converted to carry a single re-entry vehicle (RV) with an MR60 1.2-megaton yield thermonuclear warhead and associated penetration aids. Since initial deployment in 1977 aboard *L'Indomptable*, the missile has been refitted to carry the lighter but similar-yield MR61 warhead. Both types were specially hardened to resist damage from the electromagnetic pulse (EMP) and fast radiation produced when nuclear-tipped anti-ballistic missiles (from systems such a the ABM-1 'Galosh' network around Moscow) explode in their vicinity. The M20 is ejected by compressed air, and is the culmination of a missile programme that started design development in 1959 and entered operational service as the MSBS M1 in 1971. The development progressed through the uprated M2 that entered service in 1974 to the present M20. The whole 16 M20 missile outfit of a French SSBN can be launched within 15 minutes. From 1985 the M20 missile will be replaced aboard the last four of the 'Le Redoutable' class by the M4, which is virtually a new design for a MIRV payload. The last M20 missiles, however, will not be phased out until *Le Redoutable* herself is paid off in 1997.



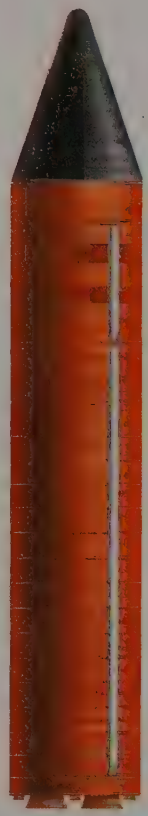
Although due to be eventually superseded by the M4, the M20 remains in service aboard the 'Le Redoubtable' class. It is armed with a 1.2-megaton yield thermonuclear warhead that is specially hardened against the effects of defensive ABM nuclear weapon systems.

Specification
M20
Type: submarine-launched ballistic missile
Dimensions: length 10.4 m (34.1 ft); diameter 1.5 m (4 ft 11 in)
Launch weight: 20054.6 kg (44,213 lb)
Performance: range 3100 km (1,926 miles); CEP 930 m (1,017 yards)
Warhead: one re-entry vehicle with an MR61 1.2-megaton weapon and penetration aids
Propulsion: solid-propellant rocket
Guidance: inertial

FRANCE

M4 SLBM

Destined to attain operational capability with *L'Inflexible* in 1985, the **Mer-Sol Balistique Stratégique M4** was tested at sea in early March 1982 from the experimental missile submarine *Gymnote*. The design of the missile was started in 1976, and the missile was fired for the very first time from a land-based test pad in November 1980. The three-stage solid-propellant weapon has a payload of six 150-kiloton yield multiple independent re-entry vehicles (MIRVs) of greater circular error probability (CEP) accuracy than previous French single-warhead SLBMs, with the added advantage of advanced penetration aids to defeat enemy ballistic missile defences. The interval between missile launchings is also shorter, and the possible launch depth is greater as a result of the use of powder charge injection, thus significantly improving the launch platform's survivability factor. All the French navy SSBNs except *Le Redoutable* are due to have the M4 retrofitted from 1985, and will thus have extensive modifications to their launch tubes, together with new fire-control and missile tube ejector systems. The refit schedule will be in the order *Le Terrible, Le Foudroyant, L'Indomptable* and *Le Tonnant*, and is to be part of the boats' normal overhaul cycles.



The M4 SLBM is due to enter service in early 1985 aboard the SNLE* L'Inflexible *(S615). The new missile has a longer range than previous French SLBMs.

Specification
M4
Type: submarine-launched ballistic missile
Dimensions: length 11.05 m (36.25 ft); diameter 1.92 m (6 ft 3.6 in)
Launch weight: 35073.2 kg (77,323 lb)
Performance: range 4000 km (2,485 miles); CEP 460 m (503 yards)
Warhead: six 150-kiloton MIRVs
Propulsion: solid-propellant rocket
Guidance: inertial

Missile Submarine Development

With a genesis reaching back to German plans of World War II, the concept of the missile-armed submarine is not new. Both the American and Soviet navies made use of captured German technology in the post-war years, but it was in the 1950s that the modern conception of the nuclear-powered, nuclear-missile-armed submarine arose.

Although the precise origins of the American submarine-launched strategic missile programme cannot be traced, it is known that on 5 March 1946 the Chief of Naval Operations ordered the conversion of two World War II fleet submarines, the USS *Cusk* and USS *Carbanero*, to carry and fire two of the air-breathing Loon missiles which had been derived from the German V-1. At the same time as the first successful Loon was launched in March 1947 from the *Cusk*, development programmes for two indigenous long-range submarine bombardment missiles were in progress; these became the Rigel and Regulus. The former was subsequently cancelled in 1953 because of launcher problems, but in the year previous the fleet submarine USS *Tunny* had been converted to carry two Regulus I missiles, which could be fired from the surfaced submarine. An additional unit, the USS *Barbero*, was later converted along the same lines, and two more units, the USS *Grayback* and USS *Growler*, were completed on the stocks as missile launchers but with capacity for four missiles.

Nuclear power

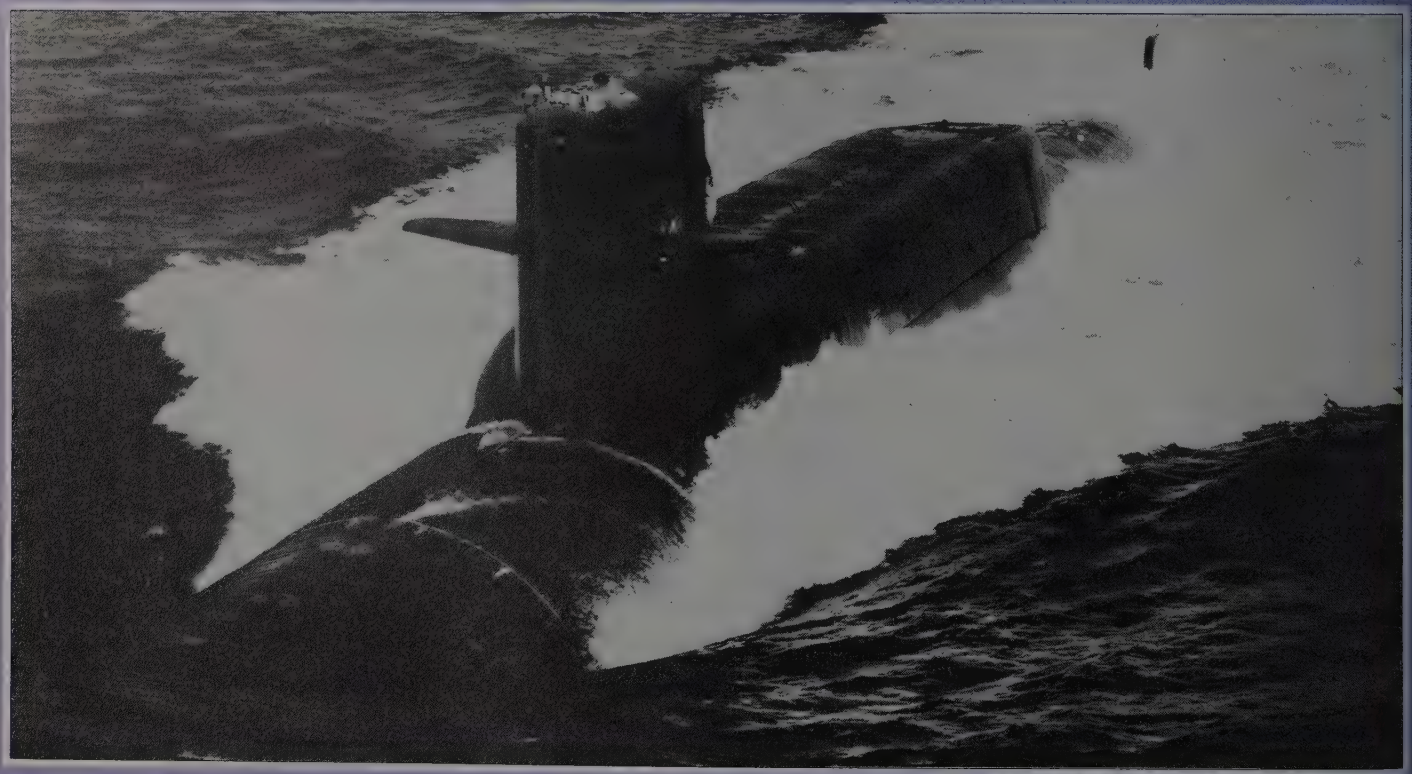
With the advent of the nuclear reactor for submarine propulsion a further conventional boat, the USS *Halibut*, which had been ordered as a Regulus carrier, was reordered in 1956 with the new propulsion system and the ability to carry five missiles. She was to have been followed by a class of even larger nuclear-powered submarines each carrying four of the larger supersonic Regulus II follow-on missiles. But in 1958 this new missile was cancelled and the submarines reordered as attack units.

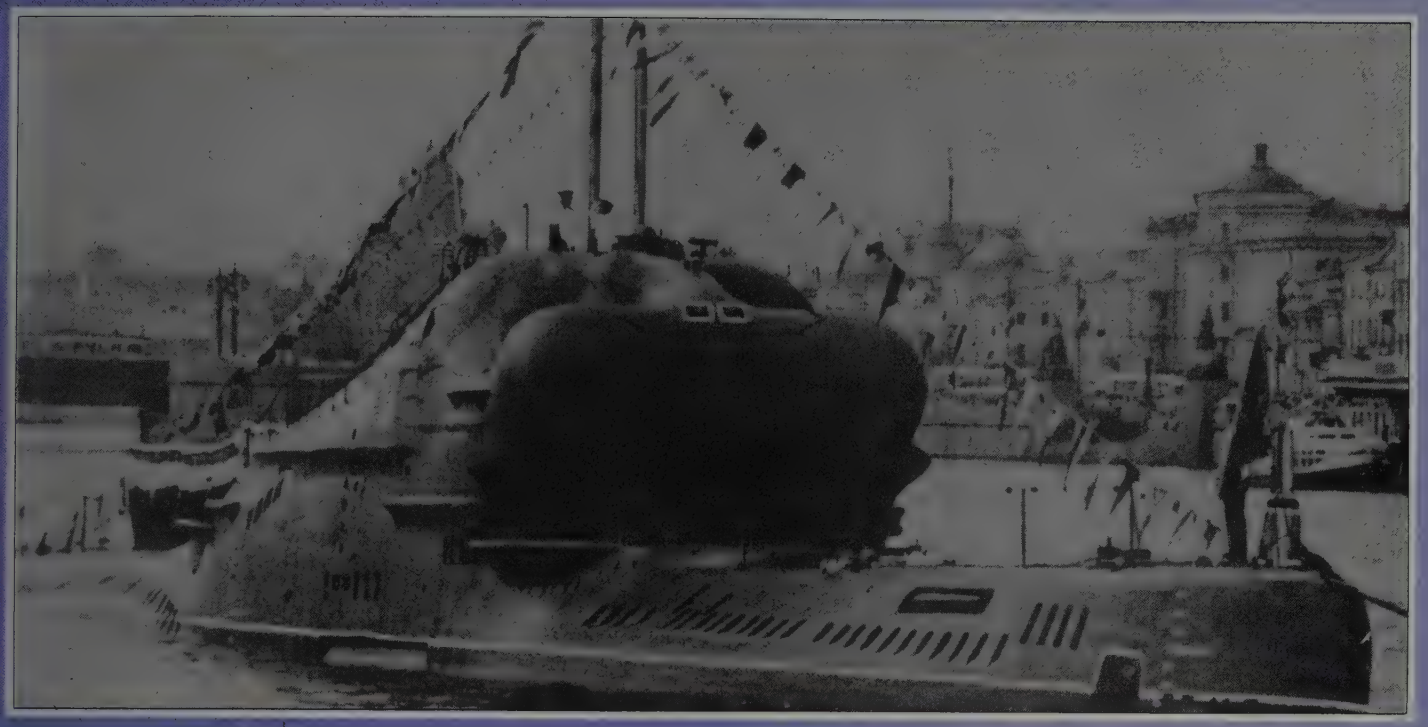
Soviet systems

The Regulus II had fallen foul of the Polaris ballistic missile. Evolved during the mid-1950s, this new type of underwater-launched missile required a projected force level of 30 submarines to be on station from a total of 45-50 units. To accommodate the 2220-km (1,380-mile) range interim Polaris A1 model a crash conversion programme was initiated in the late 1950s to install a 39.6-m (130-ft) long section for 16 missiles abaft the fin in the hulls of six 'Skipjack' class attack submarines to produce the 'George Washington' SSBN class. As these vessels were being launched so the six 'Ethan Allen' class vessels, designed from the keel up as SSBNs, were laid down. These were in effect ballistic missile versions of the contemporary 'Thresher' class SSNs and made effective use of that type's superior machinery-silencing techniques and deeper diving hull materials. Equipped with the Polaris A2 SLBMN they were rapidly followed down the production line by the still larger 31-strong 'Lafayette' and 'Benjamin Franklin' classes of SSBNs, the last 23 of which commissioned into service carrying the Polaris A3 missile. When the first Pacific Fleet SSBN carried out its first patrol at the end of 1964 so the five Regulus I submarines were phased out after seven years of patrols in the area. All of the 41 Polaris-equipped vessels were completed between 1959 and 1964, which still ranks as one of the major industrial and military achievements of recent times in

One of the first launches of Polaris A3, in 1964, signalled the culmination of the astonishing scientific and industrial achievement which marked the Polaris programme. In the space of five years the USA had built 41 boats and established a strategic advantage over the USSR that was to last into the 1980s.

Now deactivated, the USS Robert E. Lee *(SSBN601), with four sister ships, comprised the 'George Washington' class of SSBNs that was converted from the 'Skipjack' class attack submarine design to give the world's first true ballistic missile submarines.*





The follow-on class to the Soviet 'Twin Cylinder' conversions was the 'Whiskey Long Bin' type. This involved lengthening the hull and inserting a section into the sail to carry four SS-N-3C 'Shaddock' strategic cruise missile container-launchers at a fixed angle of 15 degrees.

the Western world.

Meanwhile, in the Soviet Union during the 1950s the leadership, under Khrushchev after the death of Stalin, elevated Admiral Gorshkov to the navy commander-in-chief's post with the directive to build new missile-armed submarines and surface ships to defend the Soviet homeland. Before 1956, when Gorshkov became C-in-C, the Soviets had already had in development a submarine ballistic missile programme based on technology captured from the Germans at the end of World War II. This culminated in September 1955 when a conventionally armed R-11FM missile derived from the Soviet army's 'Scud' tactical ballistic missile was launched from a converted 'Zulu' class conventional submarine. This was followed by five further 'Zulu V' conversions (1956-8, each with two missiles) and the 23 specially built Project 629 (built 1958-62, each with three missiles) 'Golf' class boats which carried the surface-launched R-13 (SS-N-4 'Sark') missile. In their usual manner of developing alternative strategic submarine systems the Soviets also designed and built the P-5 (SS-N-3C 'Shaddock') surface-launched inertially-guided 800-kiloton yield cruise missile which was tested in 1957 on a conventional submarine given the NATO codename 'Whiskey Single Cylinder'. This was followed by five 'Whiskey Twin Cylinder' (1959-61, each with two P-5s) and seven 'Whiskey Long Bin' (1961-5, each with four P-5s) conversions.

As these entered service so the Soviets also introduced their own nuclear-powered versions using a common design root. The SSBN class became known in the West as the 'Hotel I' (eight built 1959-62, each with three R-13s) whilst the SSGNs became the 'Echo I' (six built 1960-2, each with six P-5s). The latter was the only nuclear-powered class equipped with strategic cruise missiles because the Soviet navy was shifted from its strategic role in the early 1960s when the new land-based Strategic Rocket Forces assumed the task. Apart from deploying the submerged-launch R-21 (SS-N-5 'Serb') missile on seven of the 'Hotels' to give the 'Hotel II' subclass and on 13 of the 'Golfs' to give the 'Golf II' variant, the Soviet navy did not match the massive American SSBN build-up until the strategic role was reassigned to the navy as one of its primary roles. By this time Soviet military intelligence had obtained most of the relevant plans of the American 'Ethan Allen' class, together with British long-range sonar details. Thus in 1967 there entered service the first 'Yankee' SSBN that was very similar in appearance to the American class and equipped with a new long-range low frequency sonar of the type required for SSBN operations.

In a programme that matched America's SSBN construction rate, the Soviets built 34 units between 1967 and 1974 at two shipyards for

The first Soviet nuclear-powered ballistic missile submarine class was the 'Hotel' type. Reconfigured in the 1960s to carry the SS-N-5, these boats are now being phased out and are either being scrapped or converted to other roles such as submerged naval command posts.

eventual use off both coasts of the USA. However, because these vessels had to transit long distances through enemy-controlled waters to their patrol areas, the Soviets designed and tested new long-range SLBMs that could be fired from waters adjacent to the Soviet homeland and still hit targets in the USA. To accommodate these they simply took the 'Yankee' design and enlarged it to give the 12-tube 'Delta I' with the SS-N-8 and then the 16-tube 'Delta II' with the same missile. With MIRVing of submarine-launched missiles the Soviets again modified the 'Delta' to produce the 'Delta III' variant with 16 SS-N-18s.

As the Soviets introduced the first of the 'Delta' series the Americans began to deploy the Poseidon MIRV-equipped SLBM aboard their last 31 SSBNs to improve force capabilities. Its follow-on, the Trident, which offers longer range, was ultimately deemed to require a new submarine design with more missile tubes to obtain greater cost effectiveness. As an interim measure 12 of the Poseidon-equipped units were converted to carry the Trident I SLBM. The result of the new design programme was the 'Ohio' class which, with 24 missile tubes for initially the Trident I and then the Trident II when it becomes available, is the West's largest SSBN and will eventually be the only type in service with the US Navy.

As soon as the Soviets learnt of the new class they began design of their own counterpart, the incredibly large 'Typhoon' class, which attained operational status in 1983. With 20 missile tubes forward of the fin for the SS-N-20, the vessel is specifically designed for operations under the Arctic ice cap, a capability which is not matched by the West. For the future the Soviets intend to introduce a new SLBM, the SS-NX-23, into service possibly on board another 'Delta' variant, whilst the Americans are still researching the possibility of procuring a cheaper SSBN than the 'Ohios' to carry the Trident II.

Polaris and Trident

Of the other three SSBN operators, the UK built in the late 1960s the 'Resolution' class of four units with British technology but carrying the American Polaris A3 SLBM. These are due to be replaced in the mid-1990s by four 'V' class SSBNs carrying the Trident II missile system. The design will be larger than the current Polaris vessels but will have only 16 missile tubes rather than the 24 aboard comparable American submarines. France, the other European nation equipped with SSBNs, went her own way designing and building both the submarines and the missiles that they carry. The first class built was the 'Le Redoutable', the five units of which have been followed by a single interim unit, *L'Inflexible*, that is the forerunner of an entirely new design for the 1990s. More recently American intelligence has indicated that Communist China has made operational the first of the 8,800-ton 120-m (393.7-ft) long SSBNs known as the 'Xia' class. Fitted with 12 of the indigenous two-stage solid-propellant CSS-N-2 SLBM, a force of up to six units is expected to be operational by the late 1980s, targeted primarily against the Soviet Far East.

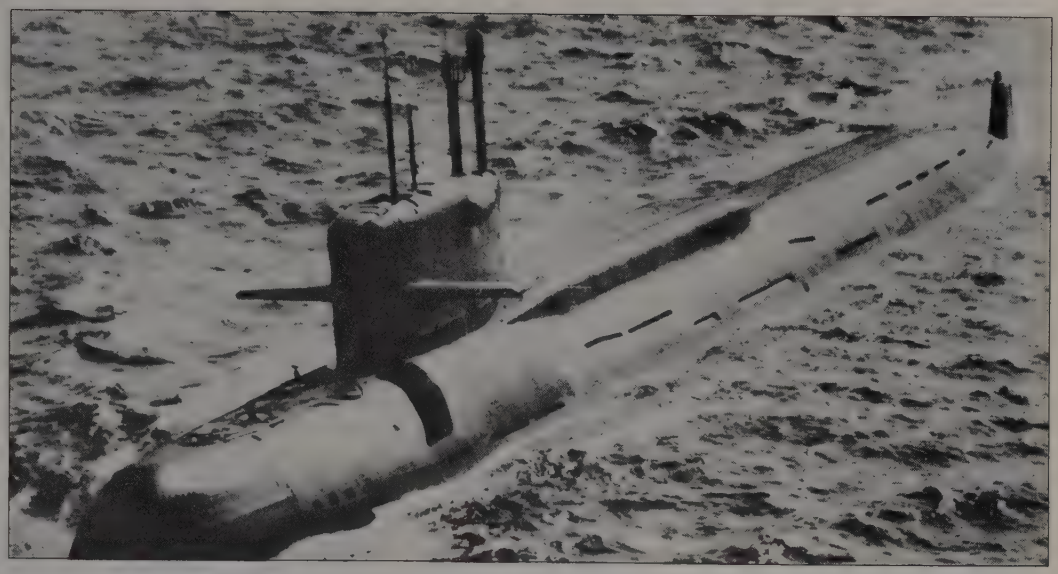
Where the SSBN goes from here is probably dependent on how successful is the development and deployment of 'Star Wars' beam and laser weapons, but what is likely is that the weapons load carried may well switch towards the strategic ultra-low-level cruise missile, with the Soviet navy probably leading the way.

A 'Yankee I' class SSBN runs on the surface. The Soviets keep several units of this type off each coast of the United States to provide a minimum warning attack on time-sensitive targets such as Strategic Air Command bomber bases in the event of a nuclear war.

The 'Ohio' class of SSBN, much larger than its predecessors, is to be armed with the Trident II missile system. The D5 missile in that system will for the first time be accurate enough to allow submarines to attack 'hard' targets.

USSR

'Yankee' class SSBN



The **'Yankee' class** was the first modern Soviet SSBN to be built. The design was apparently based on the plans of the US 'Benjamin Franklin' and 'Lafayette' classes that were covertly obtained by Soviet military intelligence (GRU) in the early 1960s. Thirty-four units were built between 1967 and 1974 at the shipyards in Severodvinsk and Komsomolsk, the peak year being 1970 when 10 vessels were completed. The 'Yankees' are distinguishable from the later 'Deltas' by having a smaller rise to the 'turtle-back' missile compartment abaft the sail. In 1976 one unit was converted to a **'Yankee II' class** configuration in which the original 16 missile tubes were replaced by 12 larger units for the experimental solid-propellant SS-NX-17 SLBM. The 'Yankee II' also differs from the similar 12-round 'Delta Is' by having a sloping forward edge to the 'turtle-back' casing of the missile tubes.

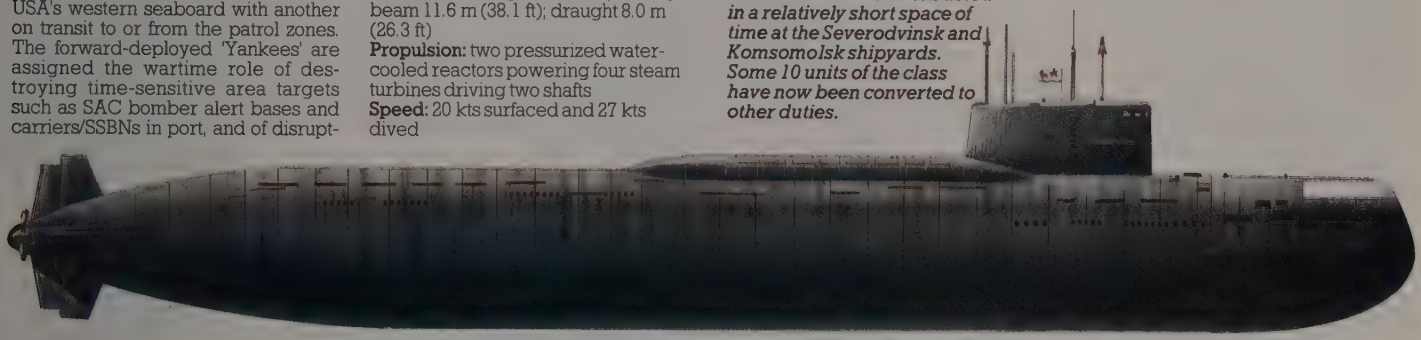
In order to comply with the SALT agreement a number of 'Yankee I' SSBNs have been deactivated as SLBM carriers. By mid-1984 10 had been so treated, a number being converted to SSNs by the complete removal of the missile section of the hull. Another has possibly become the trials platform for the highly accurate SS-N-21 533-mm (21-in) diameter 7-m (23-ft) long cruise missile with a single 200-kiloton yield warhead and a range of 3000 km (1,865 miles).

At present three or four of 14 'Yankee I' boats, plus the odd 'Yankee II' in the Northern Fleet, are on station at any one time off the eastern seaboard of the USA, with a further unit either on transit to or from a patrol area. Overlaps do occur, and these occasionally raise the number of boats on patrol. Of the nine 'Yankee Is' in the Pacific Fleet two are on permanent patrol off the USA's western seaboard with another on transit to or from the patrol zones. The forward-deployed 'Yankees' are assigned the wartime role of destroying time-sensitive area targets such as SAC bomber alert bases and carriers/SSBNs in port, and of disrupting the American higher command echelons as much as possible to ease the task of follow-up ICBM strikes. More recently, NATO sources have indicated that several of the 'Yankees' in each theatre have been switched to operate against theatre nuclear targets, with the submarines operating in sanctuary areas closer to the Soviet homeland. These vessels are believed to be replacing the older 'Hotel II' and 'Golf II' submarines in this role.

Specification
'Yankee' class
Displacement: 7,700 tons surfaced and 9,300 dived
Dimensions: length 130.0 m (426.5 ft); beam 11.6 m (38.1 ft); draught 8.0 m (26.3 ft)
Propulsion: two pressurized water-cooled reactors powering four steam turbines driving two shafts
Speed: 20 kts surfaced and 27 kts dived
Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum
Armament: 16 ('Yankee I') or 12 ('Yankee II') launch tubes for 16 SS-N-6 ('Yankee I') or 12 SS-NX-17 ('Yankee II') submarine-launched ballistic missiles, and six 533-mm (21-in) bow tubes for a maximum of 12 533-mm (21-in) weapons, though the normal load is eight 533-mm (21-in) ASW/anti-ship torpedoes and six 406-mm (16-in) ASW torpedoes
Electronics: one 'Snoop Tray' surface-search radar, one low-frequency bow sonar, one medium-frequency torpedo fire-control sonar, VHF/SHF/UHF communications systems, one VLF towed communications buoy, one ELF floating antenna, one 'Brick Group' ESM suite, and one 'Park Lamp' direction-finding antenna
Complement: 130

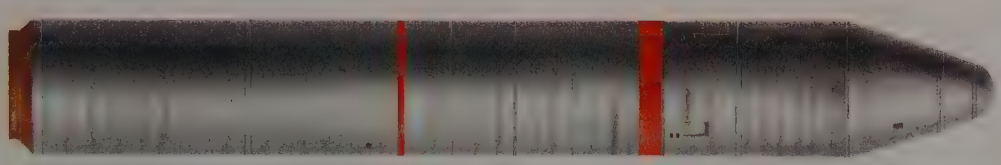
A total of 34 'Yankee I' class submarines were constructed in a relatively short space of time at the Severodvinsk and Komsomolsk shipyards. Some 10 units of the class have now been converted to other duties.

Apparently built with the aid of Polaris missile submarine plans stolen from the Americans, the 'Yankee I' class, with its SS-N-6 missiles, formed the major part of the Soviet SSBN fleet in the early 1970s.



USSR

SS-N-6 SLBM



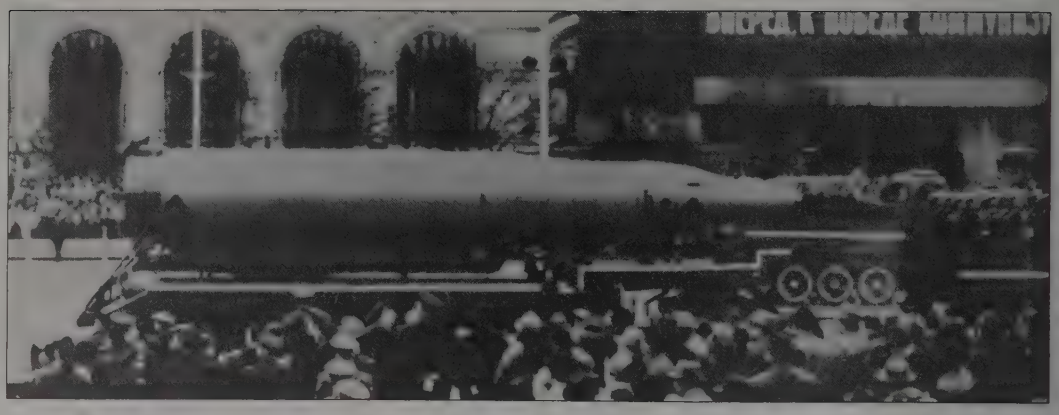
The photographs that have been released of what NATO codenames **'Sawfly'** are in fact of a competitive prototype that was never taken into service. Such ruses are a common part of Soviet disinformation exercises. The actual **SS-N-6** was tested on a diesel-electric 'Golf' class submarine that was converted around 1970 to carry and fire six such weapons in a lengthened sail structure that was added to an 18-m (59-ft) extension to the hull. Being a third-generation weapon, the missile is actually something of a hybrid as it utilizes both components and technology derived from the land-based SS-11 ICBM. It is a single-stage SLBM with liquid-propellant propulsion. The original 2400-km (1,490-mile) range **SS-N-6 Mod 1** with a single 700-kiloton yield warhead entered service two years before the 'Golf' trials boat used to test the much improved and lighter **SS-N-6 Mod 2** variant in 1972. This missile uses a 650-kiloton warhead instead of the previous one and has a 600-km (375-mile) increase in range, which enables 'Yankees' cruising off either US seaboard to provide full target coverage from the 183-m (600-ft) contour. At the same time the **SS-N-6 Mod 3** began development, initial deployment happening in 1974, one year after the SS-N-6 Mod 2. This third variant has the same range as its predecessor, but the single RV has been replaced by two 350-kiloton yield multiple re-entry vehicles (MRVs) for use against large area targets such as cities. By 1985 those 'Yankee Is' that were left in service had either SS-N-6 Mod 1 or SS-N-6 Mod 3 missiles in their tubes.

Now being used in its Mod 3 version with two Multiple Re-entry Vehicle warheads, the SS-N-6 arms the 'Yankee I' class of SSBN.

Specification
SS-N-6
Type: submarine-launched ballistic missile
Dimensions: length 10.0 m (32.8 ft); diameter 1.8 m (5 ft 10.9 in)

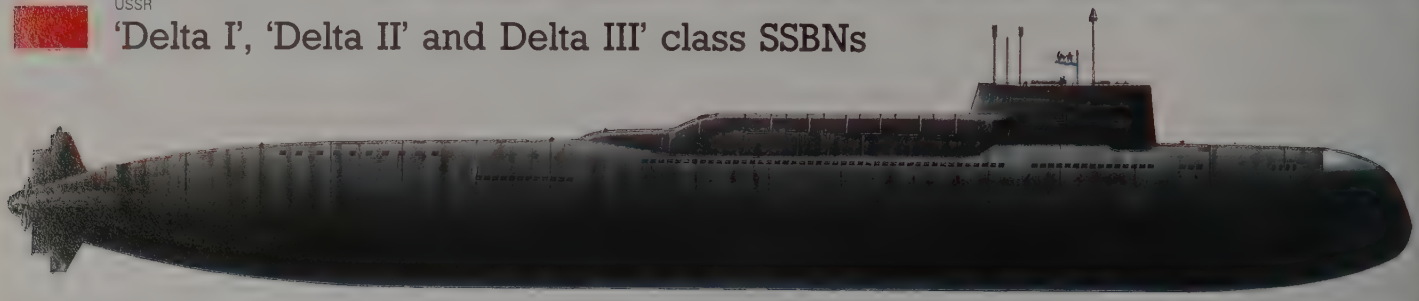
Launch weight: 18900 kg (41,667 lb)
Performance: range (Mod 1) 2400 km (1,490 miles) or (Mods 2 and 3) 3000 km (1,865 miles); CEP 1850 m (2,023 yards)
Warhead: one 700-kiloton yield re-entry vehicle in Mod 1, or one 650-kiloton yield re-entry vehicle in Mod 2, or two 350-kiloton yield MRVs in Mod 3
Propulsion: liquid-propellant rocket
Guidance: inertial

Predecessor to the SS-N-6 SLBM was the SS-N-5 'Serb'. This utilized a cold gas ejection system to fire the missile clear of the launch platform, where the main rocket motor was ignited. The 'Yankee' class SSBNs use a similar system to eject the SS-N-6 missiles from their launch tubes.



USSR

'Delta I', 'Delta II' and Delta III' class SSBNs



The **'Delta I' class** design was an enlargement of the previous 'Yankee' class design. Built initially at Severodvinsk and then at Komsomolsk in the Soviet Far East, the 'Delta I' was the world's largest undersea craft when the first unit was completed in 1972. The eighteenth and last of the class was completed at Komsomolsk in 1977. Designated a ballistic missile submarine (*podvodnaya lodka raketnaya krylataya* or PLRK) by the Soviets, the class carries two parallel rows of six missile tubes for the SS-N-8 missile aft of the sail, which is set forward with diving planes on each side.

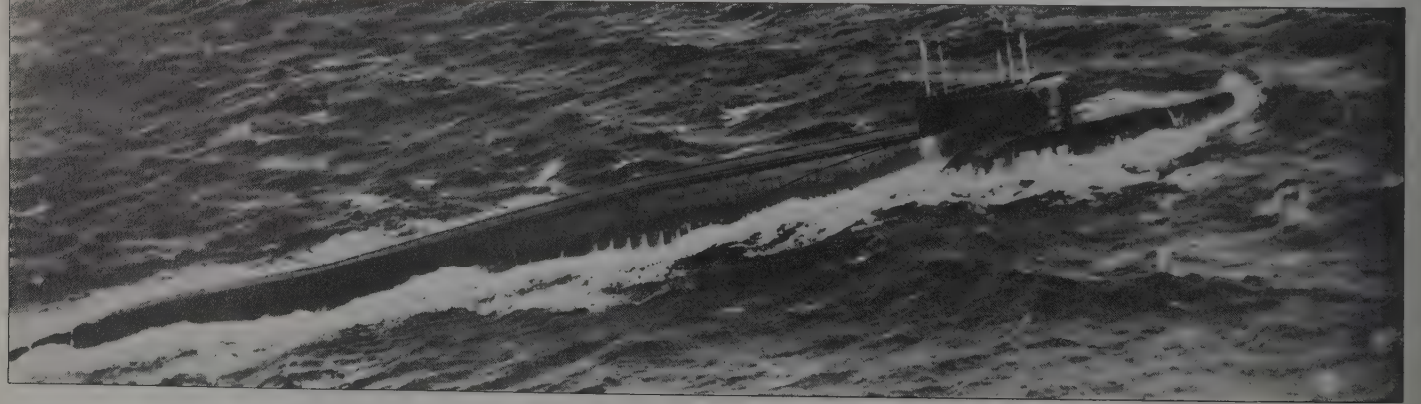
In 1975 at Severodvinsk an interim batch of four **'Delta II' class** units was constructed. These were essentially the earlier design lengthened by 16.2 m (53.2 ft) to make possible the incorporation of a further four missile tubes to match contemporary Western SSBNs. These boats were followed in 1976 by the first units of the **'Delta III' class**. They are similar to the 'Delta II' boats but have the 'turtle-back' structure aft of the sail increased in height to accommodate the longer and more capable SS-N-18 in the missile tubes.

At present the 'Delta III' is in series construction, with some 15 units built to date, and at least another two or three are expected before a new variant is introduced to carry the SS-N-23. The 22 'Delta I', 'Delta II' and 'Delta III' class vessels in the Northern Fleet have patrol areas in the Greenland, Norwegian and Barents Seas with one vessel normally on patrol in each location. More recently it has been revealed that a further unit is deployed in the eastern Atlantic, probably as far south as the Azores, in order to complicate yet further the task of US defence radars. In the Pacific Fleet only two of 15 'Delta I' or 'Delta III' class units are on patrol at any one time, one in the Sea of Okhotsk and the other in the Bering Sea. However, in time of tension the number of units on patrol would be increased considerably so that an effective second strike force would be available in a protracted nuclear exchange. It was also revealed in the latest US Department of Defense *Soviet Military Power* document that the Soviets have been practising SLBM missile resupply from tenders in protected areas, whilst those submarines in port or under refit would for protection either be dispersed to concrete-hardened tunnels built into cliffs or be submerged in the deep fjords that lie just off their piers.

Specification
'Delta' class
Displacement: 8,750 tons surfaced and 10,000 tons dived for 'Delta I', and 9,750 tons surfaced and 11,000 tons dived for 'Delta II' and 'Delta III'
Dimensions: length 136.5 m (447.8 ft) for 'Delta I' and 152.7 m (501 ft) for 'Delta II' and 'Delta III'; beam 12.0 m (39.4 ft); draught 8.7 m (28.5 ft)
Propulsion: two pressurized water-cooled reactors powering four steam turbines driving two shafts
Speed: 20 kts surfaced and 26 kts ('Delta I'), 25 kts ('Delta II') or 24 kts ('Delta III') dived
Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum
Armament: 12 ('Delta I') or 16 ('Delta II') launch tubes for 12 ('Delta I') or 16 ('Delta II') SS-N-8 submarine-launched ballistic missiles, or 16 launch tubes ('Delta III') for 16 SS-N-18 submarine-launched ballistic missiles, and six 533-mm (21-in) bow tubes for a maximum of 12 533-mm (21-in) weapons, though the normal load is eight 533-mm (21-in) ASW/anti-ship torpedoes and six 406-mm (16-in) ASW torpedoes
Electronics: one 'Snoop Tray' surface-search radar, one low-frequency bow sonar, one medium-frequency torpedo fire-control sonar, VHF/SHF/UHF communications systems, one VLF towed communications buoy, one ELF floating antenna, one 'Brick Group' ESM suite, one 'Park Lamp' direction-finding antenna, and one 'Pert Spring' satellite navigation system
Complement: 130 ('Delta I') or 140 ('Delta II' and 'Delta III')

Now into its third variant, the 'Delta' class ballistic missile submarine is essentially the 'Yankee' design lengthened to accommodate new SLBMs.

Only four 'Delta II' class submarines were built, as an interim design. The only difference between the vessels and the earlier 'Delta Is' is an increase in hull length.



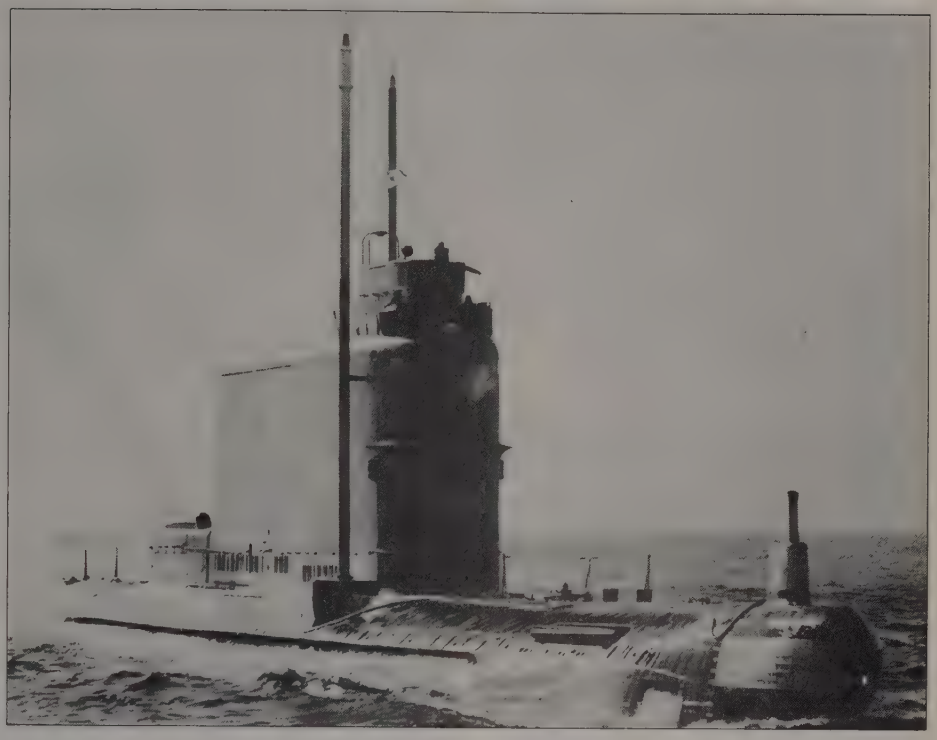
Soviet Submarines in Action

With a tradition of submarine operations, the Soviet navy has long maintained the largest submarine force in the world, the surest shield against nuclear attack being a submarine-based deterrent.

The Soviet Union maintains the world's largest force of ballistic missile submarines for strategic attack. As of March 1984 the force numbered 64 vessels embarking a total of 936 nuclear-tipped missiles. Two of the total do not count towards the SALT limit of 62 SSBNs, whilst an additional 15 older vessels with 45 embarked missiles are not included in SALT limitations because they are assigned to the theatre strike and anti-shipping roles.

The 14 units of the 'Delta III' class, together with the two 'Typhoons', were completed in the last seven years and carry the Soviets' SLBM MIRV force of 264 SS-N-18 and SS-N-20 missiles. It is these units, together with the 18 earlier 'Delta I' and four 'Delta II' class boats, which are fitted with the long-range SS-N-8 that permits the boats' assignment to patrol areas in waters adjacent to the Soviet Union. This affords the boats considerable immunity from NATO ASW operations, and also allows the submarines to fire from their home ports if required and still strike the continental USA (CONUS). The remaining 22 'Yankee I' class boats and the solitary 'Yankee II' unit are used primarily on forward-deployment patrols off both coasts of the CONUS to disrupt American strategic command, control and communications networks in the early minutes of a nuclear exchange and to destroy as many strategic weapon systems (such as SAC bombers on alert and SSBNs still in port) as possible. More recently it has learnt that several 'Yankees' have been reassigned to patrol areas on the eastern side of the Atlantic and the Norwegian sea, where as part of the Soviet theatre nuclear forces they can bombard places such as the UK. To ensure an adequate level of communications under most operating conditions, the Soviets are deploying an extremely low frequency (ELF) radio transmission system that will allow the submarines to receive messages at depths well in excess of what is achieved currently by using towed buoys and floating antennae.

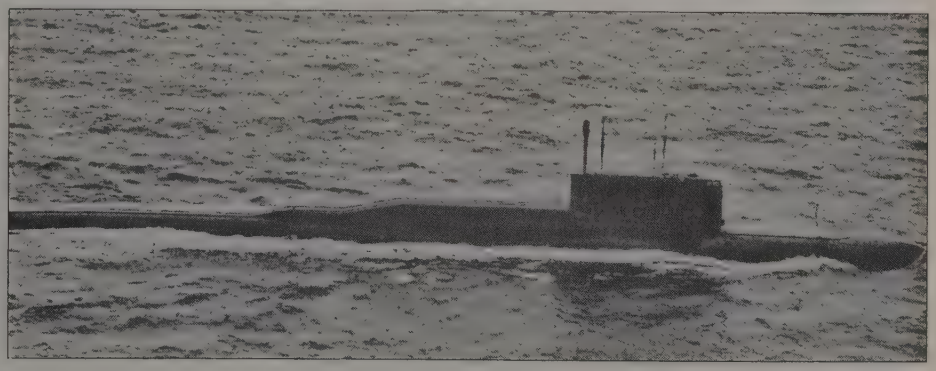
To enhance their SSBNs' capabilities further in a protracted nuclear exchange, the Soviets are regularly practising the resupply of missile-exhausted SSBNs from missile tenders anchored in protected waters, the reloading and refurbishment of the missile tubes taking less than 24 hours to complete. In these resupply zones, and in the sanctuary areas within which the SSBNs operate close to the Soviet homeland, specialist surface warship and submarine task groups with regimental-sized maritime patrol aircraft support are assigned to deal with any NATO ASW units that may attempt to attack the missile submarines. But if the Americans go after the command echelons ashore, and destroy the hardened underground bunkers which house them, then alternative mobile aircraft and multiple vehicle-based command posts are available. The SSBNs which are still under refit or simply have not sailed would be dispersed to protected camouflaged tunnels constructed near their home ports or taken out to the deep water fjords just off the docks and submerged.



One of the remaining 'Golf-II' conventional powered ballistic missile submarines is fitted with three tubes for the SS-N-5 'Serb', retained in the Northern Fleet for trials purposes.

At present the Soviet navy's Northern Fleet has the majority of the SSBN force with two 'Typhoons', 21 'Delta I/II/III', 14 'Yankee I' and the single 'Yankee II', together with several older 'Hotel II' and 'Golf' trials vessels. All are located at bases on the Kola peninsula. The Pacific Fleet, with nine 'Yankee I' and 15 'Delta I/III' class boats, has two SSBN bases, one near Petropavlovsk on the Kamchatka peninsula and the other near Vladivostok close to the junction of the Soviet, Chinese and North Korean borders. It is likely that the 'Deltas' and strategic-role 'Yankees' operate from the former as it gives access to both the Sea of Okhotsk and Bering Sea sanctuary area, whilst the latter base would house the theatre-role 'Yankees' as it is close to Japan and well within launch range of most of the important American Far Eastern bases.

The Northern Fleet missile boats have a much harder task if they want to transit to patrol areas off the US eastern seaboard or for the occasional 'Delta' that goes as far south as the Azores, since the vessels have to transit the natural series of 'choke points' known as the Greenland-Iceland-United Kingdom Gap. This offers NATO the best chance of detecting them by use of the Sound Surveillance Under Sea (SOSUS) fixed sonar array network. The remaining 'Deltas' and 'Typhoons' that operate on the Soviet side of the gap have to be hunted down by individual nuclear-powered NATO attack submarines sent into their sanctuaries on high-risk missions with little chance of survival once they have destroyed a target. To increase NATO's problems further, the 'Typhoon' force would actually be operating within the Arctic icepack which is a notoriously difficult ASW.

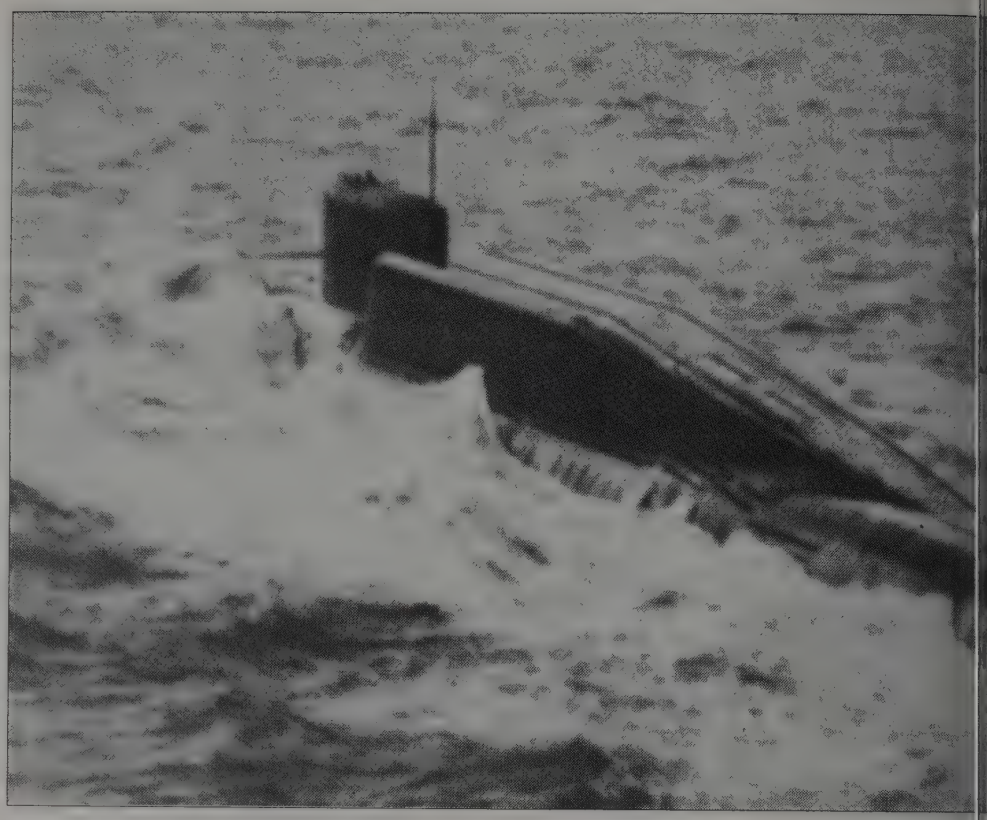


The sole 'Yankee II' SSBN is converted to carry 12 SS-N-17 instead of 16 SS-N-6 missiles. In all other respects the boat is similar to the 'Yankee I', being some two or three knots faster underwater than any of the contemporary western SSBN designs. It is based on the Kola Peninsula.

environment because of the high background noise from the moving ice flows. Submarines which hide within or just under the ice (as the 'Typhoon' is built to do) could only be detected at relatively short ranges by other submarines operating at very slow speeds, a tactical situation which nullifies the normal advantages of Western attack submarines so that the winner of any such engagement would simply be the more alert unit with the quicker trigger finger on the torpedoes. This is the main reason why both the UK and USA are placing great emphasis on under-ice ASW operations by their attack submarines, periodically announcing the sending of such craft on 'trips' to the North Pole and staging submarine exercises by several boats within the Arctic circle.

Future plans

For the future the Soviets are certain to capitalize on this NATO deficiency by increasing their 'Typhoon' fleet for under-the-ice operations and by decreasing the number of their forward-deployed 'Yankees' to the minimum required, so enhancing the survivability of their SSBN forces. A new MIRVed SLBM is already under flight test for future retrofitting to the existing 'Delta IIIs' and to arm a new mid-1980s SSBN class to complement the 'Typhoons'. Older vessels such as the 'Delta Is' may well be switched to theatre roles, while the 'Yankees' appear to be under gradual conversion to other tasks including, possibly, one of the main carriers of the Soviet submarine-launched cruise missile force of SS-N-21s.



Above: Construction of the 'Delta III' class continues at Severodvinsk at the rate of two units per year. The hatches in the aft part of the raised rear decking are believed to cover towed very low frequency communications buoys, whilst just forward of the rudder can be seen the top of a submarine rescue buoy marker.

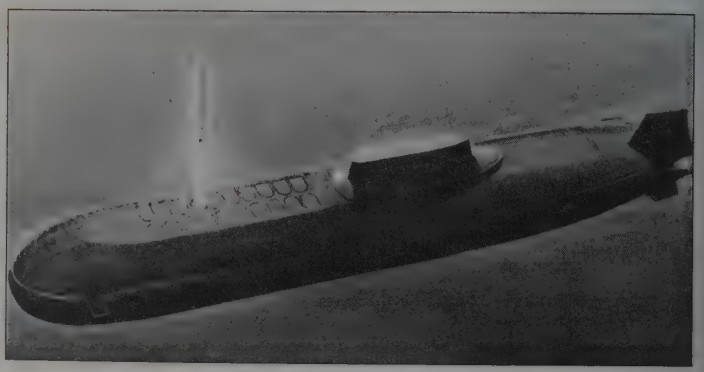
Soviet 'Delta III' class Ballistic Missile Submarine

Below: For many years the world's largest underwater vessel, the 'Delta III' class of ballistic missile submarine is a mainstay of current Soviet strategic capability. At least 15 have been built at Severodvinsk, with several more under construction, possibly in a modified form to take the next-generation SS-N-23 missile. At present the class is armed with 16 SS-N-18 MIRV missiles, each with several low-yield warheads. The SS-N-18 has a range of up to 8000 km (almost 5,000 miles).

USSR

'Typhoon' SSBN and 'SS-N-20' SLBM

A true monster of the deep, the Typhoon has been designed for operations under the polar ice. Its huge size enables it to be armed with missiles capable of hitting the continental USA without ever having to leave northern Soviet waters.



The mammoth Typhoon SSBN is thought to be comprised of two 'Delta' class hulls in a side-by-side configuration with the missile tube compartment forward of the sail.

Such submarines are being built for operations beneath and within the polar ice regions of the northern hemisphere.

The **'Typhoon' class** boats are the largest undersea vessels yet built, and are believed to be based on a catamaran-type design that comprises two 'Delta III' hulls joined by a single outer covering to give increased protection against ASW weapons. In overall size a 'Typhoon' is almost half as long again as the US 'Ohio' class Trident missile-carrying submarines, and has a displacement some 9,500 tons greater when running on the surface. It is thought that the class has been built specifically for operations with the Soviet Northern Fleet in the Arctic ice-pack. The two parallel rows of missile tubes fitted forward of the stub-like sail aft of the craft's centre point, together with the high-rise hull and retractable bow hydroplanes, allows the submarine to break easily through the spots of thin ice (known as polnyas) within the Arctic ice shelf.

The first unit was laid down in 1975 at Severodvinsk and launched in 1980. It achieved operational status in 1983. A second unit has now been completed, whilst there are at least another four under series construction in a special covered shipyard. A US intelligence report suggests that by the early 1990s eight of these monsters will be in service.

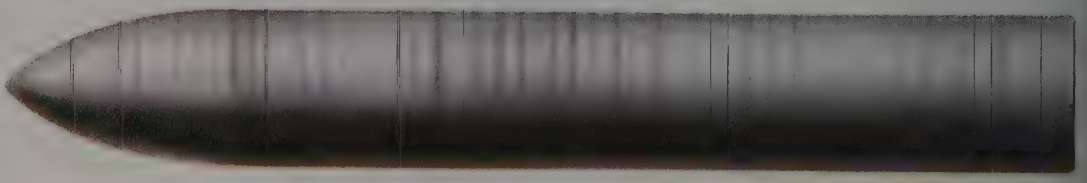
To arm the 'Typhoon' the Soviets started to design a fifth-generation SLBM, the **SS-N-20**, from 1973. First-flight tested in 1980, the SS-N-20 is a three-stage solid-propellant MIRVed missile with a range of 8300 km (5,160 miles). This allows the submarine to fire the weapon from within the Arctic circle and still hit a target anywhere within the continental USA. Before the end of this decade the Soviets are due to test fly an improved version of the SS-N-20.

Specification
'Typhoon' class
Displacement: 26,000 tons surfaced and 30,000 tons dived
Dimensions: length 170.0 m (557.7 ft); beam 23.0 m (75.5 ft); draught not known
Propulsion: four pressurized water-cooled reactors powering four steam turbines driving four shafts
Speed: 20 kts surfaced and 30 kts dived
Diving depth: 400 m (1,315 ft) operational and 600 m (1,970 ft) maximum
Armament: 20 launch tubes for 20 SS-N-20 submarine-launched ballistic missiles, and six 533-mm (21-in) bow tubes for a maximum of 24 533-mm (21-in) weapons, though the normal load is 16 533-mm (21-in) ASW/anti-ship torpedoes and 14 407-mm (16-in) ASW torpedoes
Electronics: one surface-search radar, one ESM system, one low-frequency bow sonar, one medium-frequency torpedo fire-control sonar, VHF/SHF/UHF communications systems, one VLF towed communications buoy, and one ELF floating antenna
Complement: 150

Specification
SS-N-20
Type: submarine-launched ballistic missile
Dimensions: length 15.0 m (49.2 ft); diameter 2.0 m (6 ft 6.7 in)
Launch weight: not known
Performance: range 8300 km (5,160 miles); CEP better than 1400 m (1,530 yards)
Warhead: between six and nine MIRVs of unknown yield
Propulsion: solid-propellant rocket
Guidance: stellar-inertial

USSR

SS-N-8, SS-N-18 and SS-NX-23 SLBMs



The SS-N-18 is now the mainstay of the Soviet SSBN force with the introduction into service of a version carrying Multiple Independent Re-entry Vehicle warheads.

Introduced into operational service in 1972 aboard the 'Delta I' class SSBN, the **SS-N-8** is a fourth-generation SLBM that began flight trials back in 1969 aboard a lengthened 'Hotel' class nuclear-powered ballistic missile submarine (codenamed 'Hotel III') converted to carry and fire three of the missiles in an enlarged sail. A second trials vessel was converted in the early 1970s from a diesel-electric 'Golf' class ballistic missile submarine. Codenamed 'Golf III' and fitted to carry and fire six SS-N-8s, the vessel has now been dismantled under the SALT limitations. The SS-N-8 is a two-stage liquid-propellant missile that, in its **SS-N-8 Mod 1** form, has a range of 7800 km (4,845 miles). To ensure accuracy over that range, stellar-inertial guidance is used to update the navigation computer by utilizing two 'star fixes' for mid-course flight profile corrections. In 1977 an engineering improved variant, the **SS-N-8 Mod 2**, entered service with a range of 9100 km (5,655 miles) and the same warhead.

However, two years before this the Soviets had begun flight testing of the fourth-generation 6500-km (4,040-mile) range storable liquid-propellant **SS-N-18** (Soviet designation **RSM-50**) which became operational on the 'Delta III' class in late 1976. The **SS-N-18 Mod 1** version was also the first Soviet SLBM to feature MIRV capability. This was followed in 1979 by the **SS-N-Mod 2** with a single warhead but much greater range. The SS-N-18 Mod 1 was then superseded in the same year by the **SS-N-18 Mod 3** which has a larger number of lower-yield MIRVs and the same range.

Both the SS-N-8 and the SS-N-18 are expected to be replaced by a new liquid-propellant SLBM, the **SS-NX-23**, which is of similar size to the latter missile but will have a greater throw-weight, carry more MIRVs and be considerably more accurate. It is expected to equip a 'Delta III' variant initially and then be retrofitted to the earlier boats.

Specification
SS-N-8
Type: submarine-launched ballistic missile
Dimensions: length 12.9 m (42.3 ft); diameter 1.65 m (5 ft 5 in)
Launch weight: 20400 kg (44,974 lb)
Performance: range (Mod 1) 7800 km (4,845 miles) or (Mod 2) 9100 km (5,655 miles); CEP (Mod 1) 1410 m (1,540 yards) or (Mod 2) 1550 m (1,695 yards)
Warhead: one 800-kiloton re-entry vehicle
Propulsion: liquid-propellant rocket
Guidance: stellar-inertial

Specification
SS-N-18
Type: submarine-launched ballistic missile
Dimensions: length 14.1 m (46.3 ft); diameter 1.8 m (5 ft 10.9 in)
Launch weight: 25000 kg (55,115 lb)
Performance: range (Mods 1 and 3) 6500 km (4,040 miles) or (Mod 2) 8000 km (4,970 miles); CEP (Mods 1 and 3) 1410 m (1,540 yards) or (Mod 2) 1550 m (1,695 yards)
Propulsion: liquid-propellant rocket
Guidance: stellar-inertial

Sub Patrol: the silent threat

The shield protecting both East and West from the horrors of nuclear war is to a large extent provided by the submarine forces of the respective navies operating SSBNs. To the men responsible for maintaining that shield, however, a missile patrol means isolation and tedium.

The USS John C. Calhoun *(SSBN630) enters the US Navy's forward deployment SSBN base at Holy Loch on the River Clyde in Scotland after the 1,000th American ballistic missile submarine patrol.*

As the last lines are slipped, the small tug pushes the great bulk of the SSBN towards the centre of the Clyde river and the run to the open water beyond, where the SSBN will slip beneath the waves for a lonely two-month patrol. Ahead lies the usual cat-and-mouse game with the Soviet intelligence-gathering trawler off Northern Ireland, whose job it is to record the boat's acoustic signature and to signal the boat's course back to the Soviet navy headquarters near Moscow. The Soviets already know she is due to come down the river by studying the patrol cycles, but do not know the actual date or time of departure, which are obtained by the resident GRU (Soviet military intelligence) officers, who live along the banks of the Clyde with the sole task of monitoring the movements to and from the British SSBN base at Faslane and the American submarine tender at Holy Loch.

With nuclear power for propulsion and continual regeneration of the atmosphere, the endurance of the vessel is limited only by food storage capacity and the stamina of the crew. To take full advantage of this, the Royal Navy uses two alternating crews, each with its own skipper and full complement of officers and enlisted men. One crew takes the boat on patrol whilst the other remains in the home port undergoing refresher courses, taking leave or inducting new crewmen into the routine of operations.

The skipper of the crew on patrol takes the SSBN on the surface down the river and once clear of the mouth dives it to begin a complex series of escape and evasion manoeuvres designed to outwit and confuse the watching Soviets in the trawler as to the direction taken. If by chance the Soviets have a submarine waiting to attempt to trail the SSBN, then the SSBN will halt for the appropriate 'delousing' operation by friendly units. Once free of unwelcome eyes the boat commences the trip to the patrol area fully submerged.

Where it actually goes, the route taken and the final return date is only known to the skipper. No messages are transmitted during the duration of the patrol, but the boat approaches to within several hundred feet of the surface at regular intervals to receive operational messages and short family messages at periodic intervals via the floating ELF antenna and VLF towed communications buoy that it carries. As the boat heads towards the designated patrol area at transit speed, the crew settles into the routine that will be followed for the entire cruise. Within the patrol zone the speed is reduced to only a few knots to reduce the chances of detection, but the boat will be kept within firing range of its targets in the Soviet Union at all times. The main emphasis of the daily schedules is directed towards keeping the 16 weapons in the missile tubes in the ready-to-launch status. All 16 will be available for around 95 per cent of the time spent in the patrol area, whilst 15 will be ready for over 99 per cent of the time. The crew are kept at a constant state of alert by periodical missile-firing drills, but an actual launch can only be conducted when the appropriate codes have been received for the firing panel and safety locks have been simultaneously disarmed by the skipper and one of his officers.

Evasive action

Apart from being ready to fire at any time, the boat has also to be ready to take evasive action if any strange surface or submarine craft are detected in the vicinity. To do this the boat carries the latest state-of-the-art passive sonar systems including a long-range retractable towed array which is streamed astern at every opportunity to allow monitoring of contacts out to a radius of 160 km (100 miles) or so around the boat's position. If the SSBN is detected, which both the Royal Navy and the US Navy have claimed has never been done by the Soviets, self-defence acoustic-homing torpedoes and powered decoys are carried in the forward torpedo room ready for use against any hostile intent. But these are to be used only in the final resort as the SSBN's primary defence is the boat's stealth aspects. It is because of this secrecy about location that the submarine sends no radio communications since the Soviets have a very capable radio direction-finding network based on shore stations and ferret satellites to watch out for just such transmissions.

Unlike its Soviet contemporary, the monstrous 'Typhoon' class, the 'Ohio' class of SSBN is not equipped to operate through weak spots (known as polnyas) in the polar ice. In areas where the ice forms bergs, however, modern sonar equipment would enable a submarine to shelter in the 'shadow' of the ice.

The increasing sophistication of modern ASW and SSBN hunting techniques mean that old-style short-ranged missiles would force submarines to patrol dangerous waters. The new generation of long-ranged missiles entering service will enable SSBNs to operate in ever more remote sectors in greater safety.

Crew accommodation

Internally the ballistic missile submarines are a lot bigger and roomier than other nuclear-powered submarines. The captain and the first or executive officer usually have their own cabins whilst the remaining officers share two- or three-berth rooms. The petty officers and enlisted men all have individual bunks, and the main mess is larger than normal as it also doubles up as the recreation hall, movie theatre and study area. Internal decoration is chosen to provide a pleasant working environment to help offset the boredom that may be encountered on long patrols. The ship's cooks are given more than enough food to cover the duration of the patrol and they make sure that the meals served throughout the daily cycle are to a very high culinary standard; they have the additional problem that the sailors eat in shifts as a result of watchkeeping requirements, so most types of meals have to be available at all times. To reduce the possibility of boredom talent shows, games and concerts are also arranged.

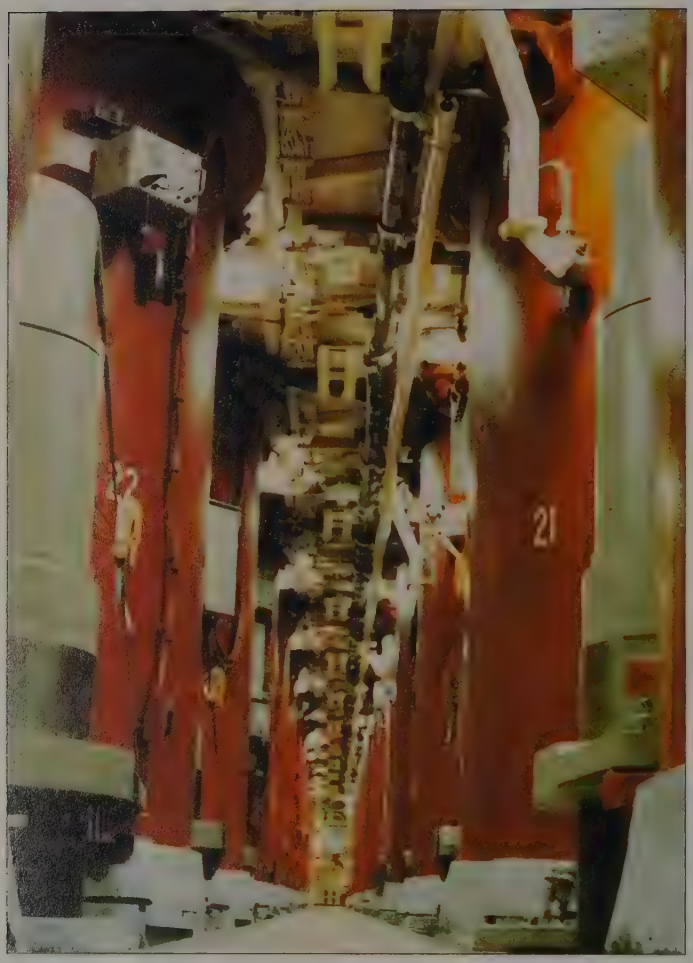
Once the time arrives for the submarine to return to base it picks up speed again for the transit, and as it starts the withdrawal the boat avoids any possible sonar contacts by using the same tactics as those employed against the Soviet trawler. The SSBN again adopts these as the Clyde estuary is approached, and surfaces near to the mouth only to make the run up the river to the docks. The crew then spends a couple of days or so handing over the boat to the other crew for the next patrol cycle. A few days before departure the boat is taken to sea for a short shakedown trip to see if the vessel and the equipment aboard are seaworthy.

Vulnerability

The SSBN is at its most vulnerable when sailing to or returning from a patrol, usually on the final leg whilst on the surface within several miles of its base. In times of tension or war it will be necessary to increase protection afforded to the vessels at these points, especially against mines and air attacks. Those SSBNs operating from the Clyde are particularly open to attack from the former as the Soviets would probably try numbers of its special ASW rising mines and underwater electrical potential influence mines on the continental shelf and continental rise just off the western isles of Scotland, astride submarine transit routes that have been determined by watching SSBN operations in peacetime. The attrition of missile submarines at such points could then easily be passed off as unintentional by-products of the conventional war phase rather than a direct assault on the West's strategic strike forces with all that entails. Although the invulnerability of the SSBN on patrol is quite often quoted by Western naval chiefs as one of the major advantages of such forces, the years of painstaking collection and collation by the Soviets of all intelligence information, hydrographic data and probable targeting patterns of Western SLBMs could easily suggest the likeliest oceanic areas for the location of patrol zones. In wartime these would therefore receive the appropriate Soviet attention up to and including the launch of ICBMs. Nor does the Western view take into consideration the introduction of new Soviet ASW systems exemplified by the recent testing of synthetic-aperture radars which can apparently detect submerged submarines down to several hundreds of feet below the surface. This means that satellite-based systems and aircraft fitted with the radar would have the ability to detect SSBNs as they hover near the surface to receive communications. If the technique actually works then the introduction of the 'Ohio' class SSBN into patrol areas even more remote from the Soviet homeland than before becomes of paramount importance, as does the introduction of the UK's new deterrent force with the Trident II SLBM if the current status quo is to be maintained.

Most modern missiles are 'cold launched', ejected from their missile tube by compressed gases, the rocket motor igniting as the weapon reaches the surface. All Western missiles have a solid propellant, but many Soviet systems are liquid-propelled.

In the past, the major deterrent effect of underwater missile systems has been the relative invulnerability of the submarine. Added to that in the future will be greatly increased accuracy, especially in the case of Trident, which will enable submarine forces to be assigned to particular targets of value instead of 'trashing' cities or area targets.



Above: The immense size of the 'Ohio' class can be gauged from this internal view of the C4 Trident I missile tube compartment. Any maintenance on the missiles whilst in their tubes is performed here, as are the continual checks to see if they are still functional.

Above: Missile submarines rely on secrecy for their own protection, the latest sonars being used to evade any hostile tactical confrontation.

Below: Although much better off than crewmen aboard conventional submarines, those on long submerged SSBN patrols can still find life tedious.

Below: The primary offensive station aboard any SSBN is the missile fire control panel. Should the unthinkable occur, the men in these positions would have the awesome responsibility of exercising the final option, and potentially causing destruction on an unparalleled scale.

USA

'Benjamin Franklin' and 'Lafayette' class SSBNs

Although actually two classes, the 12 **'Benjamin Franklin' class** and 19 **'Lafayette' class** submarines are very similar in appearance. The main difference is that the former were built with quieter machinery outfits. All have diesel-electric stand-by propulsion, snort masts and an auxiliary propeller. As built, the first eight 'Lafayettes' carried 16 single 800-kiloton yield warhead 2775-km (1,725-mile) range Polaris A2 SLBMs, the rest receiving the Polaris A3 fitted with three 200-kiloton yield MRVs. Of the Polaris A2 boats four (SSBN620 and SSBN622-625) were rearmed with the Polaris A3 during refuelling overhauls in 1968-70. In August of the latter year SSBN627 became the first of the Poseidon C3 SLBM conversions, whilst between September 1978 and December 1982 12 units were further converted to carry and fire the Trident I C4 SLBM. All 31 units serve with the Atlantic Fleet, several being forward-deployed to a submarine tender located at Holy Loch on the River Clyde in Scotland. Several units with Poseidon missiles have been reassigned to the theatre nuclear role in support of NATO. Each American SSBN is assigned two crews designated Blue and Gold, one manning the vessel during a 70-day patrol and helping during the following 32-day minor overhaul before the other crew takes the vessel out on patrol. Every six years each boat undergoes a complete overhaul and reactor refuelling that lasts about 22-23 months. The individual submarines that comprise the two classes are the USS ***Lafayette*** (SSBN616), USS ***Alexander Hamilton*** (SSBN617), USS ***Andrew Jackson*** (SSBN619), USS ***John Adams*** (SSBN620), USS ***James Monroe*** (SSBN622), USS ***Nathan Hale*** (SSBN623), USS ***Woodrow Wilson*** (SSBN624), USS ***Henry Clay*** (SSBN625), USS ***Daniel Webster*** (SSBN626), USS ***James Madison*** (SSBN627), USS ***Tecumseh*** (SSBN628), USS ***Daniel Boone*** (SSBN629), USS ***John C. Calhoun*** (SSBN630), USS ***Ulysses S. Grant*** (SSBN631), USS ***Von Steuben*** (SSBN632), USS ***Casimir Pulaski*** (SSBN633), USS ***Stonewall Jackson*** (SSBN634), USS ***Sam Rayburn*** (SSBN635), USS ***Nathaniel Greene*** (SSBN636), USS ***Benjamin Franklin*** (SSBN640), USS ***Simon Bolivar*** (SSBN641), USS ***Kamehameha*** (SSBN642), USS ***George Bancroft*** (SSBN643), USS ***Lewis and Clark*** (SSBN644), USS ***James K. Polk*** (SSBN645), USS ***George C. Marshall*** (SSBN654), USS ***Henry L. Stimson*** (SSBN655), USS ***George Washington Carver*** (SSBN656), USS ***Francis Scott Key*** (SSBN657), USS ***Mariano G. Vallejo*** (SSBN658) and USS ***Will Rogers*** (SSBN659). Those from SSBN640 onwards are of the 'Benjamin Franklin' subclass.

Specification

'Lafayette' and 'Benjamin Franklin' classes

Displacement: 7,250 tons surfaced and 8,250 tons dived

Dimensions: length 129.5 m (425.0 ft); beam 10.1 m (33.0 ft); draught 9.6 m (31.5 ft)

Propulsion: one S5W pressurized water-cooled reactor powering two steam turbines driving one shaft

Speed: 28 kts surfaced and 25 kts dived

Diving depth: 350 m (1,150 ft) operational and 465 m (1,525 ft) maximum

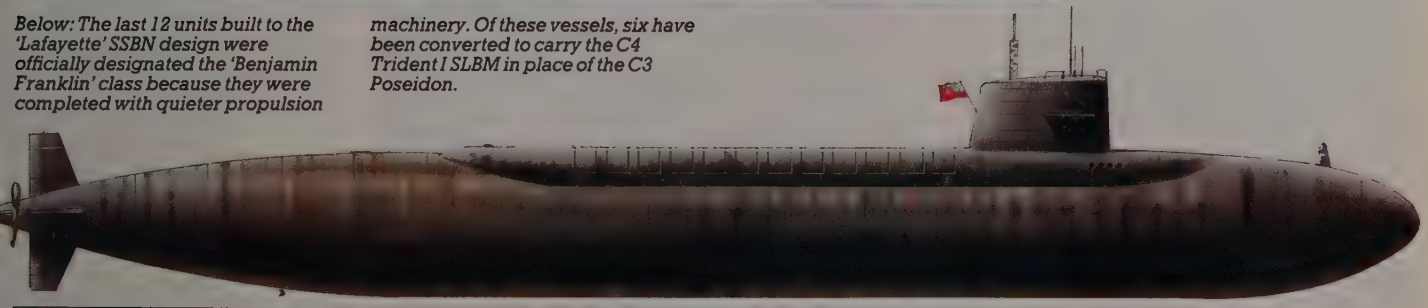
Armament: 16 launch tubes for 16 Trident I C4 (SSBNs 627, 629, 630, 632-634, 640, 641, 643, 655, 657 and 658) or for 16 Poseidon C3 (remainder) submarine-launched ballistic missiles, and four 533-mm (21-in) bow tubes for 12 Mk 48 ASW/anti-ship torpedoes

Electronics: one BPS-11A or BPS-15 surface-search radar, one ESM system, one BQR-7 sonar, one BQR-15 towed-array sonar, one BQR-19 sonar, one BQR-21 sonar, one BQS-4 sonar, and extensive communications and navigation systems

Complement: 140 ('Lafayette') or 168 ('Benjamin Franklin')

Left: The C4 Trident I-equipped 'Benjamin Franklin' class vessel USS Mariano G. Vallejo *(SSBN658). Nowadays American SSBNs do not carry identifying pennant numbers for security reasons.*

Below: The last 12 units built to the 'Lafayette' SSBN design were officially designated the 'Benjamin Franklin' class because they were completed with quieter propulsion machinery. Of these vessels, six have been converted to carry the C4 Trident I SLBM in place of the C3 Poseidon.



USA

Lockheed UGM-73A Poseidon C3 SLBM

By 1964 two follow-on designs to the Polaris were under review. One subsequently evolved into the **Lockheed UGM-73A Poseidon C3** SLBM which could use the launch tubes of the existing fleet of SSBNs. Ultimately 31 out of the original 41 SSBNs built were refitted to carry the Poseidon, although some were later fitted to carry the Trident I. The Poseidon C3 entered operational service in 1970 after initial flight tests in 1968. The missile introduced the concept of MIRVing to American SLBMs. Up to a maximum of 14 Mk 3 independently targeted RVs (each with a yield of 40 kilotons) can be carried over a range of 4000 km (2,485 miles), but with the normal loading of 10 MIRVs the range is increased to 5200 km (3,230 miles). Penetration aids to confuse defence systems are also carried. The two-stage solid-propellant missiles are targeted mainly against soft military and industrial targets such as airfields, storage depots, and above-ground command and control facilities. A total of 619 operational missiles was bought, and 304 of these plus their 3,040 associated warheads are still afloat on the remaining 19 Poseidon-equipped SSBNs. Two or three Poseidon vessels are always assigned to the NATO high command for the theatre nuclear role in Europe and the Mediterranean. The Poseidon will eventually be replaced by the Trident II.

A C3 Poseidon SLBM just after launch. One problem for an SSBN commander is that he would prefer all his SLBMs to be launched in one go and not in several groups because each firing points to his location.

Specification
Poseidon C3
Type: submarine-launched ballistic missile
Dimensions: length 10.4 m (34.1 ft); diameter 1.9 m (6 ft 2 in)
Launch weight: 29030 kg (64,000 lb)
Performance: range 4000-5200 km (2,485-3,230 miles) depending on the number of MIRVs carried; CEP 553 m (605 yards)
Warhead: between 10 and 14 MIRVs each with a 40-kiloton weapon
Propulsion: solid-propellant rocket
Guidance: inertial

Still in service aboard 19 'Lafayette/ Benjamin Franklin' class SSBNs, the C3 Poseidon can carry up to 14 relatively low-yield warheads to attack independent targets.

USA

'Ohio' class SSBN

Destined to become the mainstay of the American SSBN fleet in the next decade and after, the 'Ohio' class will eventually carry the D5 Trident II SLBM that will allow these submarines to operate in patrol zones close to the American coasts, where they can be protected more easily.

Designed in the early 1970s as the follow-on SSBN to the 'Benjamin Franklin' and 'Lafayette' classes, the lead ship of the **'Ohio' class**, the USS ***Ohio*** (SSBN726) was contracted to the Electric Boat Division of the General Dynamics Corporation in July 1974. As the result of an unfortunate series of problems both in Washington, DC, and at the shipyard, the lead vessel did not run her first sea trials until June 1981, and was not finally commissioned until November of that year, three years late. Since then further delays have occurred in the programme but the rate of production is now beginning to get back on schedule.

Each submarine is expected to have a 12-month reactor refuelling refit every nine years and will work a patrol period of 70 days with the next 25 days spent alongside a tender or jetty readying for the next patrol. Because of their longer-range Trident missiles, the 'Ohio' class boats have patrol areas in the remoter parts of the world's oceans, making effective Soviet ASW measures against them virtually impossible for the foreseeable future, especially as the boats are acoustically very quiet.

At present four 'Ohios' are in commission: the *Ohio*, the USS ***Michigan*** (SSBN727), the USS ***Florida*** (SSBN728) and the USS ***Georgia*** (SSBN729). Six more are building: the USS ***Henry M. Jackson*** (SSBN730), USS ***Alabama*** (SSBN731), USS ***Alaska*** (SSBN732), USS ***Nevada*** (SSBN733) and two unnamed boats. At least another 11 are projected. The first eight are to be based in the Pacific at Bangor, Washington, whilst the remainder will go to the Atlantic Fleet at Kings Bay, Georgia, to replace Poseidon boats. From SSBN734 onwards the 'Ohios' will carry the Trident II missile in their 20 launch tubes whilst the others will be refitted at the first available opportunity.

Specification
'Ohio' class
Displacement: 16,764 tons surfaced and 18,750 tons dived
Dimensions: length 170.7 m (560.0 ft); beam 12.8 m (42.0 ft); draught 10.8 m (35.5 ft)
Propulsion: one S8G pressurized water-cooled natural-circulation reactor powering a turbo-reduction drive to one shaft
Speed: 20 kts surfaced and 24 kts dived
Diving depth: 300 m (985 ft) operational and 500 m (1,640 ft) maximum
Armament: 24 launch tubes for 24 Trident I C4 submarine-launched ballistic missiles, and four 533-mm (21-in) bow tubes for an unknown number of tube-launched weapons
Electronics: one BPS-15A surface-search radar, one WLR-8(V) ESM system, one BQQ-6 sonar, one BQS-13 sonar, one BQS-15 sonar, one BQR-19 sonar, one BQR-23 towed-array sonar, and extensive communications and navigation systems
Complement: 133

The USS Ohio *(SSBN726) under way. This class represents the latest in American technology, and is designed to defeat all foreseeable ASW threats that the Soviets are known to possess or believed to be capable of developing.*

UK

'Resolution' class SSBN

Although constructed in the United Kingdom, the four 'Resolution' class SSBNs have a considerable amount of their internal systems based on American components that were used in the 'Lafayette' class.

Officially stated in February 1963 was the British government's intention to order four or five **'Resolution' class** Polaris missile-equipped 7,000-ton nuclear-powered submarines that would take over the nuclear deterrent role from the Royal Air Force's V-bomber force from 1968 onwards. The first two pairs of boats were ordered in May 1963 from Vickers Shipbuilding Ltd, Barrow-in-Furness, and Cammell Laird & Co. Ltd, Birkenhead; the option on a fifth unit was cancelled in February 1965. With characteristics very similar to the American 'Lafayettes' the lead ship HMS ***Resolution*** (S22) was launched in September 1966 and commissioned in October of the following year. The second vessel, HMS ***Repulse*** (S23), followed in September 1968, with the third, HMS ***Renown*** (S24), and fourth, HMS ***Revenge*** (S27), commissioning in November 1968 and December 1969 respectively. Early in 1968 the *Resolution* sailed to Florida in the United States for missile launch trials, making the UK's first successful Polaris launch on 15 February. Four months later she sailed on her first deterrent patrol. As in French and American SSBNs, two crews (Port and Starboard) are used to maximize the time spent at sea, each patrol lasting around three months. When not aboard the crews take leave and undergo refresher training at the 10th Submarine Squadron base at Faslane on the Clyde. According to current plans the Polaris boats are to be replaced on a one-for-one basis from 1994 onwards by four 'V' class Trident II missile-carrying submarines. All four boats have recently undergone conversions during normal overhauls to carry the Polaris A–TK variant fitted with the Chevaline MRV warhead system.

Specification
'Resolution' class
Displacement: 7,500 tons surfaced and 8,400 tons dived
Dimensions: length 129.5 m (425.0 ft); beam 10.1 m (33.0 ft); draught 9.1 m (30.0 ft)
Propulsion: one pressurized water-cooled reactor powering two steam turbines driving one shaft
Speed: 20 kts surfaced and 25 kts dived
Diving depth: 350 m (1,150 ft) operational and 465 m (1,525 ft) maximum
Armament: 16 launch tubes for 16 Polaris A3TK submarine-launched ballistic missiles, and six 533-mm (21-in) bow tubes for an unknown number of tube-launched weapons
Electronics: one Type 1003 surface-search radar, one type 2001 bow sonar, one Type 2007 sonar, one Type 2023 retractable towed-array sonar, one ESM suite, and an extensive communications outfit
Complement: 135

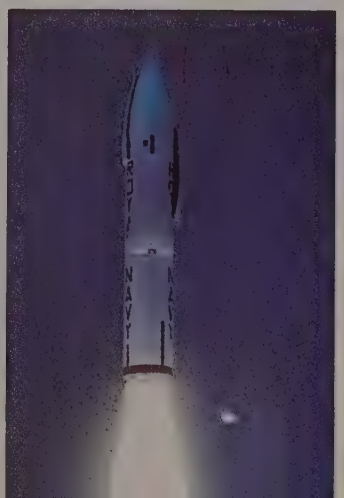
HMS **Revenge** *(S27). In 1983 she became the second of Britain's Polaris submarines to operate with the upgraded Polaris A3TK Chevaline system designed to penetrate Soviet ABM defences around Moscow.*

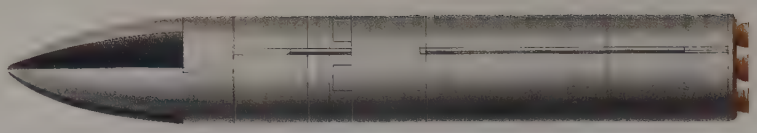
USA/UK

Lockheed UGM-27C Polaris A3 SLBM

Now the sole user of the US-designed **Lockheed UGM-27C Polaris A3** SLBM, the Royal Navy has recently had its stockpile of Polaris missiles re-engined so that it can continue as the UK's nuclear deterrent force, with a range of 4748 km (2,950 miles). The British buy of the missile was, according to US Congressional records, 102 with another 30 purchased later to make up attrition. These were equipped with three British-designed and -built 200-kiloton yield MRVs for use against area targets such as cities and oilfields: the effect of a single high-yield warhead falls off rapidly with distance from the point of impact, whereas several smaller-yield weapons around the target perimeter cause significantly more damage. However, as a result of Soviet developments in ABM defences it was decided in the early 1970s that countermeasures would have to be built into the Polaris system. The result was the **Polaris A3TK Chevaline** project, which had its roots in a cancelled US warhead programme called Antelope. Chevaline involves the replacement of the 200-kiloton MRVs with three 60-kiloton weapons hardened against EMP and fast radiation, as well as the modification of the carrier bus to present defending radar systems with a confusingly large number of credible threats at the same time, with the result that the incoming warhead picture is swamped. Although not specified, these modifications are believed to include the fitting of chaff penetration aids and the possible carriage of decoys that on re-entry behave as real warheads do. The first submarine to be retrofitted with the new system was HMS *Renown*. As each boat comes in for refuelling she is converted to the new missile system.

Now used only by the United Kingdom, the Polaris A3 SLBM is undergoing a rocket-motor replacement programme.





Equipping the 'R' class submarines of the Royal Navy, the Polaris A3 is the last model of the pioneering SLBM to remain operational.

Specification
Polaris A3TK
Type: submarine-launched ballistic missile
Dimensions: length 9.8 m (32.2 ft); diameter 1.4 m (4 ft 6 in)
Launch weight: 15876 kg (35,000 lb)
Performance: range 4748 km (2,950 miles); CEP 930 m (1,017 yards)
Warhead: three 60-kiloton yield MRVs plus an unknown number of decoys and chaff penetration aids
Propulsion: solid-propellant rocket
Guidance: inertial

USA

Lockheed UGM-96A Trident I C4 SLBM

The purpose of the **Lockheed UGM-96A Trident I C4** missile development programme was essentially to increase the range of American SLBMs to allow the use of larger and remoter patrol areas. A three-stage solid-propellant missile, the Trident I was flight tested in 1977, becoming operational two years later aboard the SSBN conversions of the 'Benjamin Franklin' and 'Lafayette' classes. The first two stages of the missile are essentially the same as those fitted to the earlier Poseidon C3 SLBM, but the third stage is fitted with stellar-inertial guidance to give the required accuracy over the longer range. The first eight 'Ohio' class SSBNs are being fitted to carry the Trident I, but these will eventually be retrofitted to carry the yet longer-ranged Trident II in the early 1990s. Rapid onboard targeting to another pre-planned target coordinates package is possible, but a far lengthier operation is required if the system has to be fed new target coordinates from an external source. As increased range was considered to be more important than accuracy improvement, a CEP comparable with that of the Poseidon was accepted. The use of higher-yield warheads, however, allows more hardened military and industrial targets to be engaged on a satisfactory basis than was possible with the earlier missile, and as such it is believed that one Trident-equipped submarine will have its re-entry vehicles assigned to NATO for use in the theatre nuclear role. A total of 740 missiles is to be procured, with eight MIRVs per missile. Eventually, in the next century, the American SSBN force will be a mix only of 'Ohio' class boats with Trident II missiles.

At enormous cost, the Trident programme will provide the seaborne element of the US strategic deterrent for the foreseeable future. Trident I employs the 7400-km (4,600-mile) ranged C4 missile, which will eventually be replaced by the D5.

Fitted to 12 of the 'Lafayette/ Benjamin Franklin' class SSBNs and the new 'Ohios', the C4 Trident I SLBM proves the nearest American equivalent to the long-range Soviet SLBMs but with more accurate payloads of MRV warheads.

Specification
Trident I C4
Type: submarine-launched ballistic missile
Dimensions: length 10.4 m (34.1 ft); diameter 1.9 m (6 ft 2.8 in)
Launch weight: 31751 kg (70,000 lb)
Performance: range 6808 km (4,230 miles); CEP 549 m (600 yards)
Warhead: eight MIRVs each with a 100-kiloton weapon
Propulsion: solid-propellant rocket
Guidance: stellar-inertial

USA

Lockheed Trident II D5 SLBM

The **Lockheed Trident II D5** is the result of an improved accuracy programme for American SLBMs begun in Fiscal Year 1975. Scheduled for operational deployment on 'Ohio' class SSBNs from the ninth vessel onwards in December 1989, the Trident II will be more accurate and have the ability to carry a greater number of larger-yield warheads than its predecessor, the Trident I. The accuracy will be sufficient to make feasible the targeting of Soviet hardened underground missile silos and command bunkers. This will be the first time ever that American sea-based strategic forces will have had the capability to attack any Soviet target type. In addition to the Trident II the programme is aimed at increasing the number of warhead vehicles available to something like the total at the height of the Poseidon programme, but with greater megatonnage to match Soviet increases. A minimum of 857 missiles will be procured for the 20 or more 'Ohio' class submarines.

A further batch of around 100 (to be serviced in the USA) will be procured by the UK, as in 1982 it was decided that this missile would be adopted for the new 'V' class submarines that are to replace the Polaris boats in the mid-1990s. The British missiles will differ in that they will carry only eight lower-yield MIRVs designed and built by the Atomic Weapons Research Establishment and Royal Ordnance Factories. This lower number of lighter warheads will allow the missiles to be fired over even longer ranges than the US versions.

Specification
Trident II D5
Type: submarine-launched ballistic missile
Dimensions: length 13.96 m (45.8 ft); diameter 1.89 m (6 ft 2.4 in)
Launch weight: 57153 kg (126,000 lb)
Performance: range 7400-11100 km (4,600-6,900 miles) depending on number of MIRVs carried; CEP 92.5 m (101 yards)
Warhead: between eight and 14 MIRVs each with a 375-kiloton weapon
Propulsion: solid-propellant rocket
Guidance: stellar-inertial

British Army Part 4

Army Air Corps

The Army Air Corps has five main roles, namely observation and reconnaissance, armed action in the anti-tank role, direction of artillery fire, command and control for land-based units, and movement of men and material (to a limited degree only).

To carry out these duties within BAOR the Army Air Corps is organized into army aviation regiments. Each of these regiments (there are basically three) is part of an armoured division establishment, and comes directly under the control of the armoured division headquarters. Each regiment has two squadrons, one equipped with Westland Lynx helicopters and the other with Aérospatiale Gazelles.

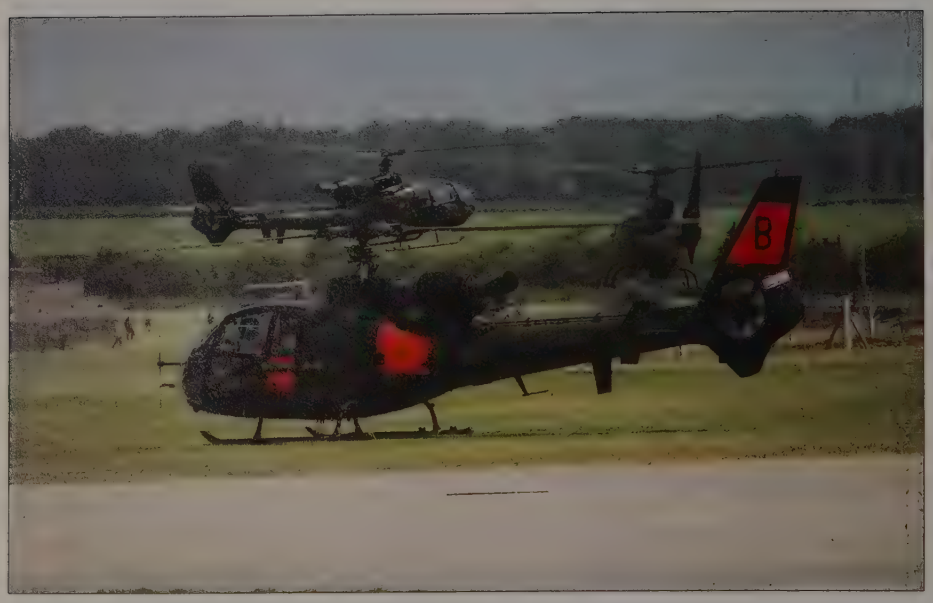
The Lynx squadron has a basis of 12 helicopters, but this might vary in some squadrons. The Lynx is charged with the anti-tank role and is equipped with up to eight TOW anti-tank guided missiles. TOW is an American wire-guided missile with a maximum range of 3750 m (4,100 yards) and weighing approximately 24 kg (52.9 lb). This makes the TOW a very powerful anti-tank weapon and the Lynx/TOW combination is regarded as among the best anti-tank weapon systems in use in NATO. The Lynx helicopter crews have developed special anti-tank tactics and frequently train with their equivalents from other NATO nations.

The Gazelle's main combat use is artillery observation and spotting, but it also has an important liaison role and is frequently used by senior commanders as a mobile command post. One squadron of Gazelles is deployed at I (BR) Corps level for just this role. The Gazelle is also widely used at all levels for general reconnaissance.

The Lynx can carry a crew of two and up to 10 soldiers, although it is not intended that it will often be used for the troop-carrying role, a task undertaken for the army by the Royal Air Force. The Lynx is a fairly large helicopter with a fuselage length of

The shape of AAC equipment in the future? This Pilatus Britten-Norman Islander has recently been displayed under the acronym CASTOR (Corps Airborne Stand-off Radar) in an attempt to meet the army's battlefield reconnaissance requirements.

This Westland Lynx AH.Mk 1 sports a full complement of eight Hughes TOW ATGMs. An additional six to eight missiles can be carried in the cabin for re-arming and a wide range of other weapons is available.



11.665 m (38.27 ft), but it is fast and manoeuvrable. In the anti-tank role Lynx helicopters normally operate in pairs.

In contrast Gazelles tend to operate individually. Apart from the pilot the Gazelle can accommodate only four passengers, and no armament is carried. In place of the seating special equipment such as night-vision devices can be carried, and it is possible to use the Gazelle as a flying ambulance.

In the United Kingdom some army aviation squadrons continue to use the Westland Scout helicopter, and the one army aviation squadron to be formed in the Territorial Army will also use the Scout. The Scout is a sturdy multi-purpose helicopter that at one time used the AS.11 wire-guided missile for the anti-tank role, but this has now been assumed by the Lynx/TOW combination. At various times machine-guns have been fitted to the Scout, either on over-skid mountings or on pintles to be fired from the main cabin.

The only other helicopter used operationally by the Army Air Corps is the Aérospatiale Alouette AH.Mk 2. This is now used in small numbers only (about eight all told) for liaison and the carriage of VIPs, but most of the Alouettes are based in Cyprus for use with the UNIFCYP forces.

The Army Air Corps uses only one type of fixed-wing aircraft for operations, and that is the venerable de Havilland Canada Beaver AL.Mk 1. This is used for a variety of purposes that range from small-scale supply dropping to general communications. They can be used for photographic reconnaissance and casualty evacuation, and have been fitted with loudspeakers for 'voice from the sky' purposes. There is no definite establishment for the Beaver as they are deployed as and when required. About eight are left in service, some of them in Northern Ireland and at least one at the BATUS training area in Canada.

Middle Wallop in Hampshire is the main base for the Army Air Corps and also acts as the corps' training base. For flying training de Havilland Chipmunk T.Mk 10s are used for basic training, followed by Bell 47Js for basic helicopter training; these Bell 47Js are operated under contract with a civilian organization. For advanced training Lynxes and Gazelles are used.

The Army Air Corps operates about eight Beavers, about 20 Chipmunks, about 40 Scouts, eight Alouettes, 155 Gazelles and approximately 80 Lynxes, not all of which are fitted for TOW.

A busy scene at the Army Air Corps base, Middle Wallop, as three Gazelle AH.Mk1s prepare for operations. The nearest machine, XW885/B, is operated by the Advanced Rotary Wing School (ARWS), as indicated by the Day-Glo patches, while the two in the background are from BAOR.

The equipment of the modern British infantryman: on the left, the GPMG on a tripod for the sustained fire role; on the right, a Carl Gustav RR and a LAW. The soldier himself sports the new pattern helmet and carries the Enfield 5.56-mm Individual weapon.

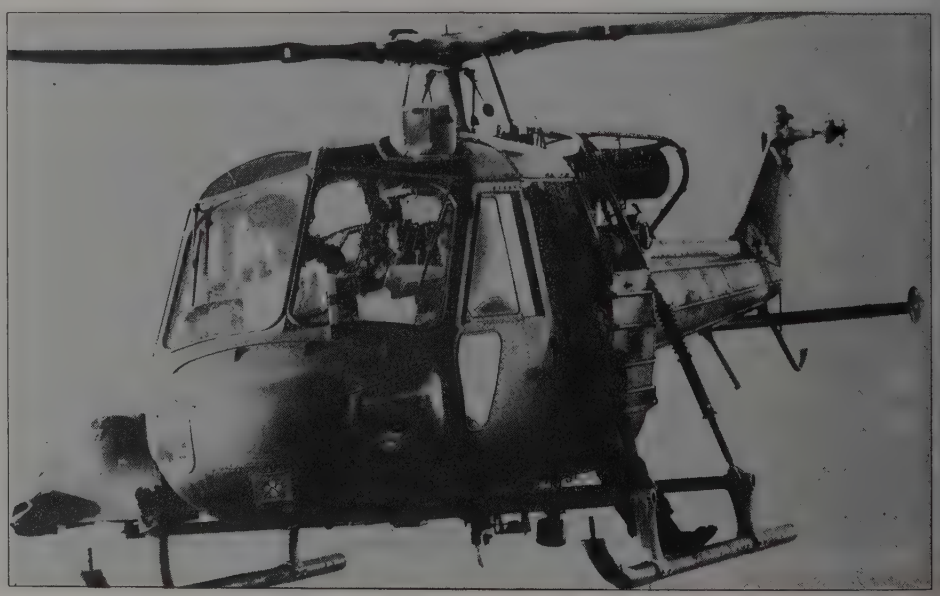
British Army order of battle

29 headquarters units
12 armoured regiments
7 armoured reconnaissance regiments
53 infantry battalions (including 6 Ghurka battalions)
3 parachute battalions (only 2 in para role)
1 Special Air Service regiment
1 missile regiment (Lance)
3 air defence regiments (Rapier)
17 artillery regiments
1 locating regiment
4 independent anti-tank units
10 engineer regiments
1 armoured engineer regiment
1 amphibious engineer regiment
1 independent engineer squadron
4 army aviation regiments

Territorial Army order of battle

2 infantry brigades
5 armoured reconnaissance regiments
35 infantry battalions
2 Special Air Service regiments
2 field artillery regiments (Light Gun)
3 light air defence regiments (Blowpipe)
7 engineer regiments
1 army aviation squadron
11 battalions Ulster Defence Regiment

A true workhorse during the Falklands war, and currently replacing the Lynx in the garrison Army Air squadron, the Westland Scout AH.Mk 1 is seen here transporting troops during the conflict. Note the stabilized optical tracking sight above the cockpit for use with the Nord AS.11 air-to-surface missiles.



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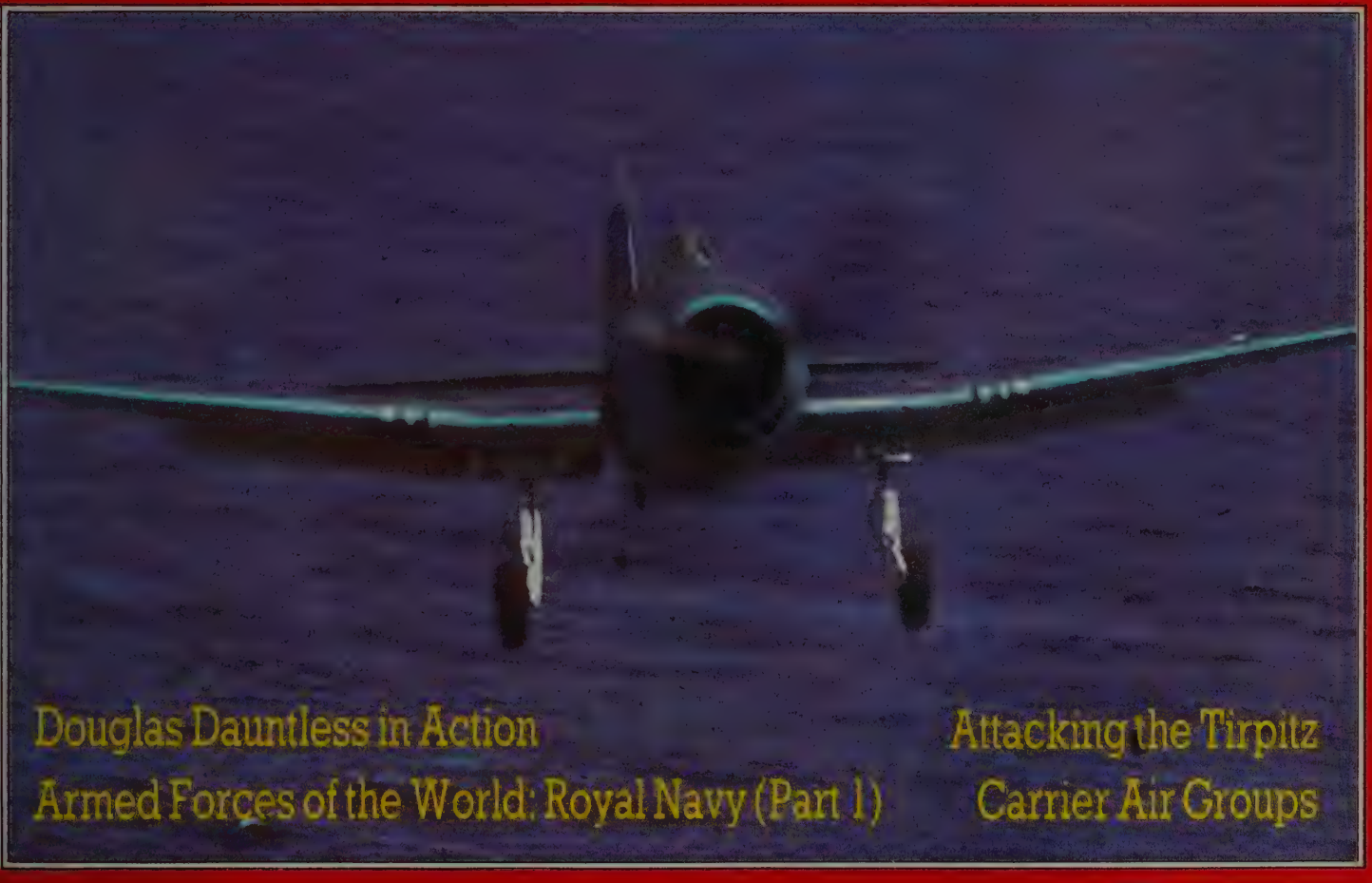

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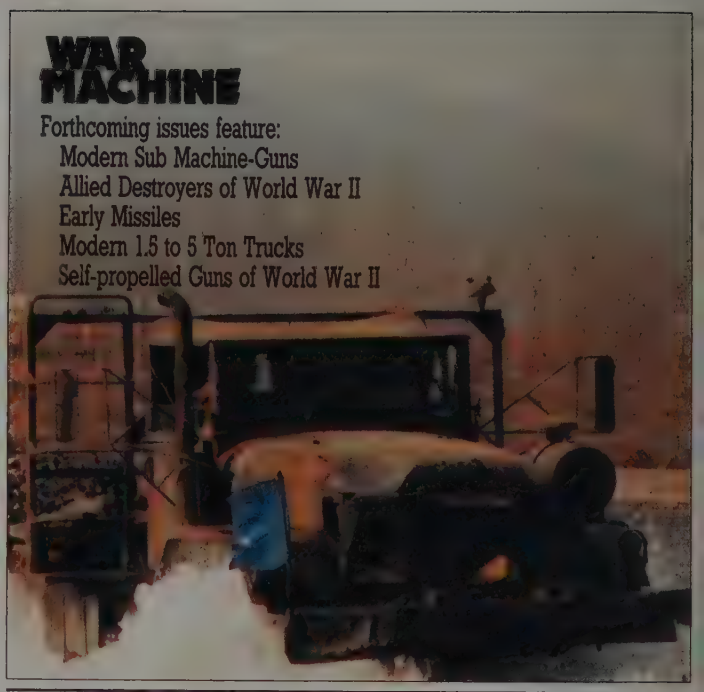

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Carrier Aircraft of World War II

Carrierborne airpower reached such a peak in World War II that several battles in the Pacific were fought solely with carrierborne aircraft. Elsewhere the carriers were protecting convoys, fighting submarines and covering beach assaults.

Deck accidents were commonplace throughout the war, when the fevered pitch of operations forced errors in men and failures of machinery. This Seafire Mk IIC was the victim of a snapped arrester wire.

The overwhelming importance of carrierborne air power to warfare at sea was only dimly foreseen in the years prior to World War II. The battleship and naval gunnery had dominated the oceans from the days of the Spanish Armada to the Battle of Jutland, and battleships outnumbered carriers considerably in the navies of the world. Nevertheless, the 1930s saw the evolution of the methods and tactics that were to dominate the Pacific War and also contribute greatly to the successful conclusion of the war in the Atlantic. It was the US Navy who was to become the master of carrier warfare, but both the Royal Navy and the Imperial Japanese navy had made significant contributions.

The demands made by this new form of warfare were considerable, especially upon the aircraft used and upon the young men who flew them. The 'controlled crash' of a carrier landing demanded strong nerves and a strong aircraft, particularly in any sea state which could cause the deck to pitch and roll alarmingly.

In general, purpose-designed carrier aircraft had inferior performance when compared to their land-based contemporaries – although this did not prevent the Fairey Swordfish from amassing a war record second to none – and conversions of landplanes such as the Supermarine Spitfire produced performance at the expense of durability. It was left to the Japanese to show that the carrier aircraft, in the shape of the Mitsubishi A6M Zero, could outfly and outfight land-based opponents.

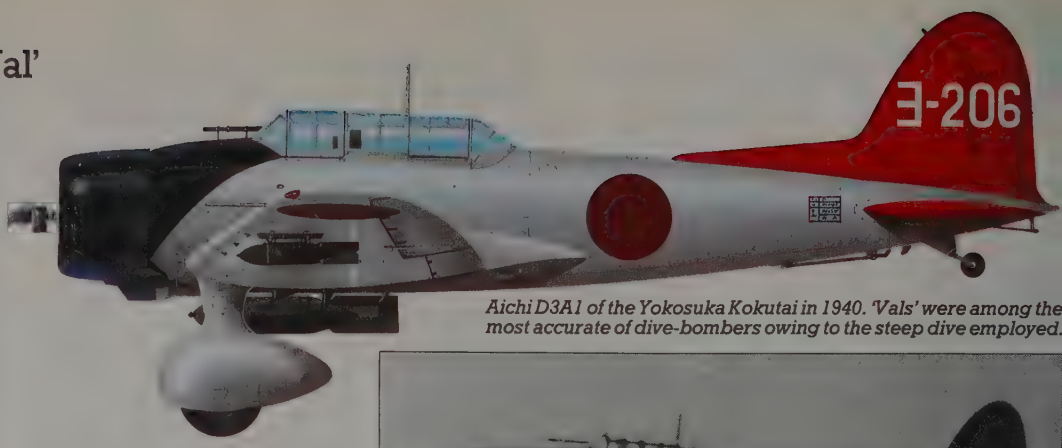
It was, however, the swarm of big, beefy US Navy aircraft based upon the massive American carrier force that was to prove decisive. Led by the Grumman F6F Hellcat and the Vought F4U Corsair, US and Allied naval aircraft in their thousands ranged the skies over Japan during the final months of the war, in a display of naval air power undreamed of only five years before.

A scene repeated many times throughout the war: Grumman TBF Avengers set off on a mission in the Pacific. This theatre brought total carrier war into the minds of the military strategists, and it was to be carrierborne air power that won the war in this vast ocean.

JAPAN

Aichi D3A 'Val'

Although thought to be obsolescent when Japan entered the war, the **Aichi D3A** with fixed spatted landing gear was the first Japanese aircraft to drop bombs on American targets when aircraft of this type took part in the great raid on Pearl Harbor on 7 December 1941. Designed to a 1936 carrier-based dive-bomber requirement, the prototype was flown in January 1938 with a 529.4-kW (710-hp) Nakajima Hikari 1 radial. Production **D3A1** aircraft had slightly smaller wings and were powered by the 745.7-kW (1,000-hp) Mitsubishi Kinsei 43 radial. A dorsal fin extension considerably improved the aircraft's manoeuvrability, although the armament of only two forward-firing 7.7-mm (0.303-in) machine-guns, with another of the same calibre in the rear cockpit, was undeniably puny. After limited land-based operations in China and Indo-China, D3As were flown in all major carrier actions during the first 10 months of the war and sank more Allied naval vessels than any other Axis aircraft. Among British casualties in D3A1 attacks were HMS *Hermes* (the world's first carrier to be sunk by carrier aircraft), and the cruisers *Cornwall* and *Dorsetshire*. Heavy losses among D3A1s during and after the Battle of the Coral Sea, however, forced withdrawal by most of the survivors to land bases. In 1942 the **D3A2** was introduced with increased fuel capacity and more powerful engine, but by 1944 the aircraft were hopelessly outclassed by American fighters; a small number was subsequently employed in *kamikaze* attacks. Production amounted to 476 D3A1s and 1,016 D3A2. The Allied reporting name was 'Val'.



Aichi D3A1 of the Yokosuka Kokutai in 1940. 'Vals' were among the most accurate of dive-bombers owing to the steep dive employed.

The D3A was the standard dive-bomber of the Japanese air groups during the early years of the campaign. Its most notable successes were the attacks on Pearl Harbor and the sinking of the British carrier HMS Hermes. This is the better-looking D3A2.

Specification

Aichi D3A2

Type: two-seat carrierborne dive-bomber

Powerplant: one 969.4-kW (1,300-hp) Mitsubishi Kinsei 54 radial piston engine

Performance: maximum speed 430 km/h (267 mph) at 6200 m (20,341 ft); climb to 3000 m (9,843 ft) in 5.76 minutes; service ceiling 10500 m (34,449 ft); range 1352 km (840 miles)

Weights: empty 2570 kg (5,666 lb); maximum take-off 3800 kg (8,378 lb)

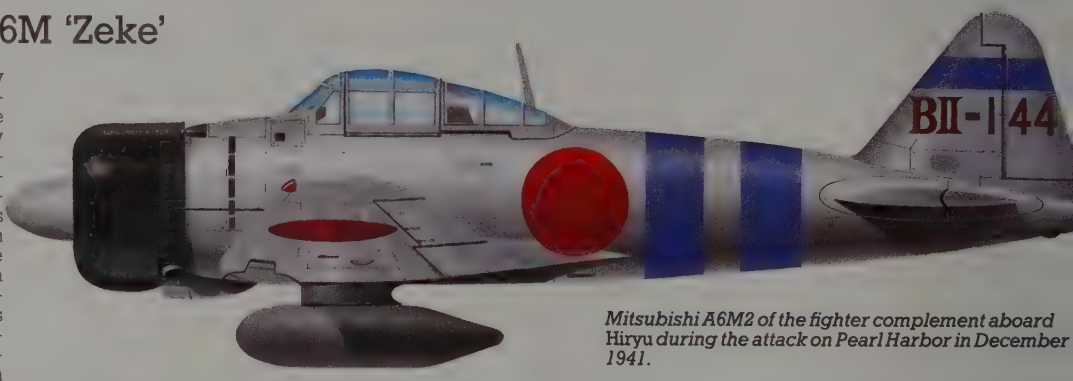
Dimensions: span 14.38 m (47 ft 2.1 in); length 10.20 m (33 ft 5.6 in); height 3.85 m (12 ft 7.6 in); wing area 34.90 m² (375.7 sq ft)

Armament: two forward-firing 7.7-mm (0.303-in) Type 97 machine-guns in the nose and one trainable 7.7-mm (0.303-in) Type 92 gun in the rear cockpit, plus one 250-kg (551-lb) bomb under the fuselage and two 60-kg (132-lb) bombs under the wings

JAPAN

Mitsubishi A6M 'Zeke'

The famous **Mitsubishi A6M**, popularly known as the **'Zero'**, was the first carrierborne fighter in the world capable of outperforming any contemporary land-based fighter it was likely to confront. Because of inept Allied intelligence it was able to achieve immediate air superiority over the East Indies and South East Asia from the day Japan entered the war. Designed under the leadership of Jiro Horikoshi in 1937 as a replacement for the neat but obsolescent A5M, the prototype **A6M1** was first flown on 1 April 1939 with a 581.6-kW (780-hp) Mitsubishi Zuisei 13 radial; production **A6M2** fighters with two wing-mounted 20-mm guns and two nose-mounted 7.7-mm (0.303-in) guns were fitted with the 708.4-kW (950-hp) Nakajima Sakae 12 radial, and it was with this version that the Japanese navy escorted the raiding force sent against Pearl Harbor, and gained air superiority over Malaya, the Philippines and Burma. In the spring of 1942 the **A6M3** with two-stage supercharged Sakae 21 entered service, later aircraft having their folding wing tips removed. The Battle of Midway represented the Zero's combat zenith; thereafter the agile Japanese fighter found itself ever more outclassed by the American F6F Hellcat and P-38 Lightning. To counter the new American fighters the **A6M5** was rushed to front-line units; this version, with Sakae 21 engine and improved exhaust system, possessed a top speed of 565 km/h (351 mph), more A6M5s (and subvariants) being produced than any other Japanese aircraft. It was five A6M5s of the Shikishima *kamikaze* unit that sank the carrier *St Lo* and damaged three others on 25 October 1944.



Mitsubishi A6M2 of the fighter complement aboard Hiryu during the attack on Pearl Harbor in December 1941.

Other versions were the **A6M6** with water-methanol boosted Sakae 31 engine and the **A6M7** fighter/dive-bomber. Total production of all A6Ms was 10,937. (The reporting name **'Zeke'** was given to the A6M, and **'Rufe'** to a float version, the **A6M2-N**.)

Specification

Mitsubishi A6M5b 'Zeke'

Type: single-seat carrierborne fighter

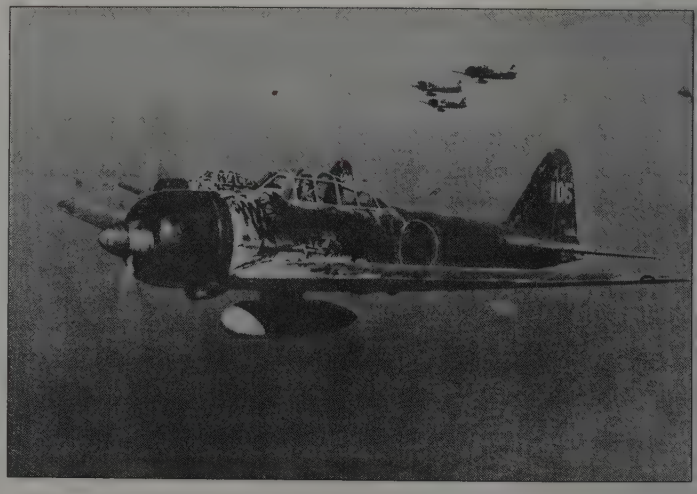
Powerplant: one 820.3-kW (1,100-hp) Nakajima NK2F Sakae 21 radial piston engine

Performance: maximum speed 565 km/h (351 mph) at 6000 m (19,685 ft); climb to 6000 m (19,685 ft) in 7.0 minutes; service ceiling 11740 m (38,517 ft); range 1143 km (710 miles)

Weights: empty 1876 kg (4,136 lb); normal loaded 2733 kg (6,025 lb)

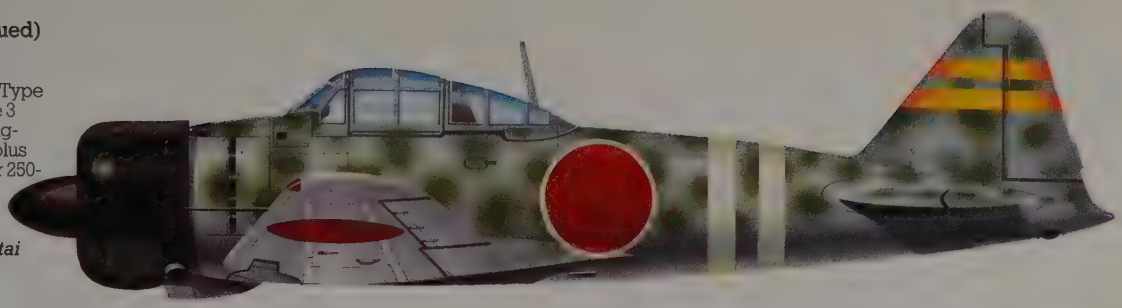
Dimensions: span 11.00 m (36 ft 1.1 in); length 9.12 m (29 ft 11.1 in); height 3.51 m (11 ft 6.2 in); wing area 21.30 m² (229.28 sq ft)

Feared by all Allied pilots before the arrival of the Hellcat in Pacific waters, the A6M featured astonishing manoeuvrability and good endurance, especially when equipped with an underfuselage fuel tank, as here. These A6M2s are on a long-range fighter patrol.



Mitsubishi A6M 'Zeke' (continued)

Armament: one 7.7-mm (0.303-in) Type 97 and one 13.2-mm (0.52-in) Type 3 machine-gun in nose, and two wing-mounted 20-mm type 99 cannon, plus underwing provision for two 60- or 250-kg (132- or 551-lb) bombs



Mitsubishi A6M2 of the 6th Kokutai based at Rabaul, New Britain, in November 1942.

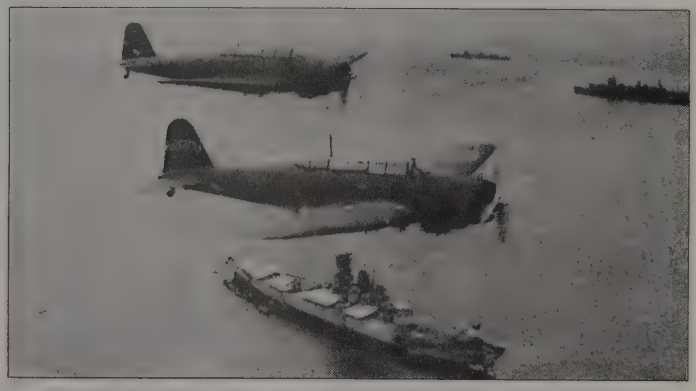
JAPAN

Nakajima B5N 'Kate'

Nakajima B5N of a Japanese navy unit. This type was responsible for many successful attacks on Allied shipping in the Pacific theatre.

Designed to a 1935 requirement, and already in service for four years when Japan entered the war, the **Nakajima B5N** was in 1941 without question the best carrierborne torpedo-bomber in the world. Powered by a Nakajima Hikari radial engine, the low-wing three-crew monoplane with inwards-retracting wide-track landing gear was exceptionally clean, and first flew in January 1937. The following year production **B5N1** aircraft were embarking in Japan's carriers and shore-based units were deployed in China. In 1939 the improved **B5N2** appeared with a more powerful Sakae 11 engine in a smaller cowling, although armament and bombload were unchanged, and this version remained in production until 1943. When Japan attacked the USA the B5N2 had wholly replaced the B5N1 with operational units, and 144 B5N2s were involved in the fateful attack on Pearl Harbor; within the next 12 months aircraft of this type sank the American carriers USS *Hornet*, *Lexington* and *Yorktown*. Given the reporting name **'Kate'** by the Allies, the B5N certainly earned the respect of the Americans, and in all the major carrier battles of the Pacific War attracted the undivided attention of defending fighters. With its puny defensive armament of a single machine-gun and laden with a large bomb or torpedo, however, the B5N began to suffer very heavily, and although the type was fully committed during the Solomons campaign the survivors were withdrawn from combat after the Philippine battles of 1944. Thereafter, on account of their excellent range, they were assigned to anti-submarine and maritime reconnaissance duties in areas beyond the range of Allied fighters. Production of all B5Ns reached 1,149.

Specification
Nakajima B5N2 'Kate'
Type: three-crew carrierborne torpedo-bomber
Powerplant: one 745.7-kW (1,000hp) Nakajima NK1B Sakae 11 radial piston engine
Performance: maximum speed 378 km/h (235 mph) at 3600 m (11,811 ft); climb to 3000 m (9,843 ft) in 7.7 minutes; service ceiling 8260 m (27,100 ft); range 1990 km (1,237 miles)
Weights: empty 2279 kg (5,024 lb); maximum take-off 4100 kg (9,039 lb)
Dimensions: span 15.52 m (50 ft 11 in); length 10.30 m (33 ft 9.5 in); height 3.70 m (12 ft 1.7 in); wing area 37.70 m^2 (405.8 sq ft
Armament: one 7.7-mm (0.303-in) Type 92 trainable machine-gun in rear cockpit, plus one 800-kg (1,764-lb) torpedo or an equivalent weight of bombs



These two B5Ns are seen flying over the mighty 70,000-ton battleship **Yamato** *(the largest ever). The underfuselage shackles for the torpedo (or bombs) are visible.*

JAPAN

Nakajima B6N 'Jill'

Nakajima B6N2 Tenzan of the Imperial Japanese Navy. This type was designed to supersede the B5N and saw intensive use during the latter part of the war.

At a time when the triumphs of the B5N were still almost three years in the future, the Japanese navy issued a specification for a replacement, recognizing that only limited overall design improvement of the B5N could be achieved in the B5N2. Accordingly design went ahead in 1939 of the **Nakajima B6N** and, despite the navy's preference for the Mitsubishsi Kasei radial, a Nakajima Mamoru was selected for the prototype which flew early in 1941. Superficially the **B6N Tenzan** (heavenly mountain) resembled the earlier aircraft, but the much increased power and torque of the big engine and four-blade propeller was found to impose considerable directional stability problems, demanding that the vertical tail surfaces be offset to one side. Flight trials dragged on, and were further delayed by troubles during carrier acceptance tests; then Nakajima was ordered to stop production of the Mamoru engine, so modifications had to be introduced to suit installation of the Kasei. In due course **B6N1** aircraft (of which only 133 were built) were embarked in the carriers *Shokaku, Taiho, Hiyo, Junyo* and *Zuikaku*, and took part in the great Battle of the Philippine Sea of June 1943, many being lost when the three first-named carriers were sunk. In that month production started of the slightly improved **B6N2** (of which 1,133 were produced before the end of the war), but the heavy losses among Japanese carriers resulted in the **'Jill'** being largely deployed ashore, particularly after the Battle of Leyte Gulf. Thereafter many B5Ns were consigned to the *kamikaze* role.

Specification
Nakajima B6N2 'Jill'
Type: three-crew carrierborne torpedo bomber
Powerplant: one 1379.5-kW (1,850-hp) Mitsubishi MK4T Kasei 25 radial piston engine
Performance: maximum speed 481 km/h (299 mph) at 4900 m (16,076 ft); climb to 5000 m (16,404 ft) in 10.4 minutes; service ceiling 9040 m (29,659 ft); range 1746 km (1,085 miles)
Weights: empty 3010 kg (6,636 lb); maximum take-off 5650 kg (12,456 lb)
Dimensions: span 14.89 m (48 ft 10.2 in); length 10.87 m (35 ft 8 in); height 3.80 m (12 ft 5.6 in); wing area 37.20 m^2 (400.43 sq ft)
Armament: one trainable 13-mm (0.51-in) Type 2 machine-gun in rear cockpit and one 7.7-mm (0.303-in) Type 97 machine-gun in ventral tunnel position, plus one 800-kg (1,764-lb) torpedo or an equivalent weight of bombs

Carrier Air Groups

The start of the war saw carrierborne air power well organized but still lacking experience. Throughout the conflict, the skills and technology were honed to a fine art, and ships, aircraft and tactics advanced to the stage where the carrier and its air group were in many ways the spearhead of the armed forces.

When World War II broke out in 1939, it might be claimed that aircraft-carriers were still in their adolescence, largely because of the length of time taken to perfect equipment, an example being the fact that it was not until 15 years after the end of World War I that transverse arrester wires were finally adopted.

Of the six Royal Navy carriers in commission in 1939, only two had been designed as such from the outset (HMS *Ark Royal* and *Hermes*), the others all being conversions (HMS *Furious*, *Glorious*, *Courageous* and *Argus*). The *Argus* was promoted to front-line work only after the loss of the *Ark Royal* in November 1941.

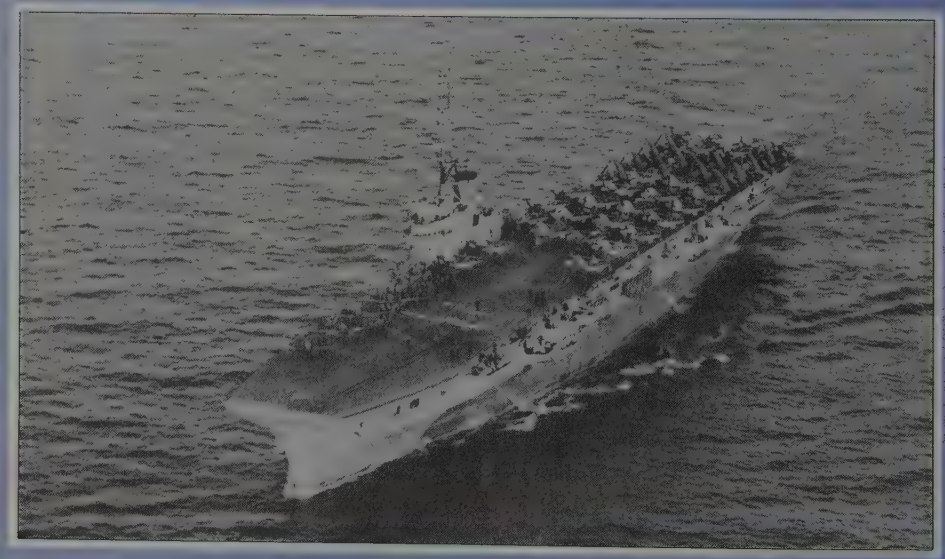
It has to be admitted that there was a further half-dozen under construction (HMS *Illustrious*, *Formidable*, *Victorious*, *Indomitable*, *Indefatigable* and *Implacable*). But they were obviously not going to be available for some years, and the growing seriousness of the Battle of the Atlantic meant the adoption of a stop-gap measure, the use of MACships (Merchant Aircraft Carrier ships, which were merely merchant vessels fitted with small flight decks) and escort carriers (converted merchantmen with between-deck hangars and full aircraft arresting gear, with defensive guns and radar).

A residual effect of the 1922 Washington Treaty, restricting the size of carriers, had resulted in British vessels being smaller than some, but able to police a far-flung empire, so that broadly the Royal Navy tended to operate small groups or even single carriers. Their equipment was divided between obsolescent aircraft like the Fairey Swordfish and the Gloster Sea Gladiator (the former type successfully carrying out the assault on Taranto in November 1940 to which a two-carrier group was originally designated) and such modern types as the Fairey Fulmar fighter (still handicapped by the stipulated necessity to carry a navigator) and the Blackburn Skua dive-bomber. Those from the *Ark Royal*'s No. 800 Squadron were used to attack the French battleship *Richelieu* off Dakar in September 1940, about a year before the introduction of CAM-ships (Catapult Armed Merchant ships) designed to protect convoys against aerial attack using a specially modified version of the Hawker Hurricane which was designated Sea Hurricane Mk 1A. It was the first time that the Royal Navy had received an aeroplane with a performance comparable to that of land-based fighters.

As the war progressed, new monoplane fighters became available, including the Vought Corsair, Grumman Wildcat, Fairey Firefly and of course the Supermarine Seafire, together with new bombers such as the Grumman Avenger and the Fairey Barracuda, so that the Royal Navy was able to make heavy raids simultaneously on the battleship *Tirpitz* in Norwegian waters and against Japanese shore installations in the East Indies.

Indeed, it was in the Pacific that the Royal Navy was able to mount attacks from larger carrier groups in a relatively small area where Allied control had been secured. In this the operations were similar to those of the USA and Japan, although in all spheres advances had been made including the introduction of airborne radar, rocket armament, catapults built into the carrier decks so that whole squadron could be ranged on the rear end of the flight deck for an operation (perhaps the beginning of angle-deck thinking), or alternatively RATOG (Rocket-Assisted Take-Off Gear).

The improvement in British carrier groups is amply illustrated in this picture of HMS Colossus in May 1945. On her decks are Fairey Barracudas, Supermarine Seafires and the excellent Vought Corsair.



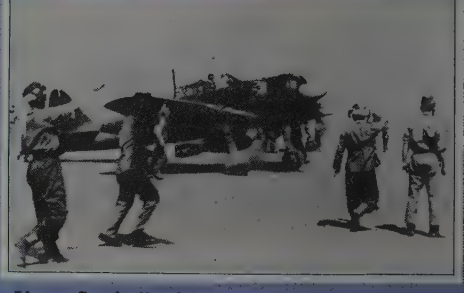
Japanese attack force

Like the Americans, the Japanese realized that operations in the wide confines of the Pacific were best carried out by large carrier groups, so that even the attack on Pearl Harbor was made from a force of six carriers (termed the 1st Air Fleet) with the 42,000-ton *Akagi* as flagship, with their aircraft numbers specially enlarged to total 430 machines. These in the main consisted of Nakajima B5N level bombers, also capable of delivering torpedoes, Aichi D3A dive-bombers and the inevitable Mistubishi A6M fighters, with a top speed of around 160 km/h (100 mph) more than that of, for example, the handicapped Fulmar. The Grumman F4Fs which had been accepted by the US Navy a year before could better the Japanese figure by some 26 km/h (16 mph). Thus rudely flung into the greater conflict, the USA had a force of seven carriers, including the 'Yorktown' class USS *Hornet*, commissioned only in the previous month, and the elderly *Langley*. This was one fewer than Japan, which boasted the strongest carrier force in the Pacific. And this force was in process of augmentation to even greater strength.

Having been equipped with Gloster Sea Gladiators and Fairey Swordfish, the Fleet Air Arm welcomed modern types such as the Fulmar and Blackburn Skua into action. However, neither type was able to hold its own against enemy aircraft.

First of the war-construction Japanese carriers was the *Taiho* of 29,300 tons, at the time of delivery the most heavily protected 'flat-top' in the world with 95 mm (3.74 in) of plating on the flight deck for the 150 m (492 ft) between the lifts, which themselves had 50-mm (1.97-in) tops.

The size of the carrier groups that could be committed to Pacific operations is well illustrated by the force that was seen approaching in box formation on the opening morning of the decisive Battle of Midway. This consisted of the *Hiryu* with her 64 aircraft leading the port column with the *Soryu* (the same total of 'Zero' fighters, 'Val' dive-bombers and 'Kate' bombers) only 3600 m (3,940 yards) astern. On the other side of the defensive formation was the flagship *Akagi*, with the *Kaga* bringing up the rear. The operation was an attempt to lure the US Pacific Fleet into a trap off Hawaii, but it misfired and all members of the Japanese carrier group were crippled by Douglas SBD Dauntless dive-bombers although the USA lost the USS *Yorktown* (Task Force 17) which had been flung into the fray with the *Enterprise* and the *Hornet* making up Task Force 16. It was the division of the American force which contributed to victory, since the Japanese had believed that the *Yorktown* was the only carrier



Above: Symbolic of the state of Japanese air power in the last months of the war, a Mitsubishi A6M, once the scourge of Allied pilots, is cheered by ground crew as it sets off for a kamikaze mission during the battle of Leyte Gulf.

The second USS Yorktown *(CV-10) demonstrates its ability to land aircraft whilst sailing backwards.* Yorktown *was second of the 'Essex' class, which were to dominate the final proceedings of the Pacific war.*

Kamikaze! A Japanese pilot attempts to hit the Hellcat-laden deck of the USS Sangamon. *Such attacks became frequent from October 1944 onwards and by the last great battle at Okinawa had become the main Japanese method of attack.*

Although well-defended, aircraft carriers often suffered great damage when hit with so many aircraft in close proximity. USS Enterprise *was lucky here to escape with only a few aircraft lost after it was damaged by a bomb at Iwo Jima.*

present and that the earlier fire aboard marked her doom.

The loss of the four big carriers in this operation made it impossible for Japan to bring her powerful fleet into action, and thereafter her naval power began slowly to recede. This is not to say that there was no Japanese kick still left for the Americans to absorb, despite Japan's loss of the light carrier *Shoho*, sunk during her first and last action one month before and the first Japanese 'flat-top' to go to the bottom.

Nevertheless, the summer of 1944 found the greater part of Japan's fleet still at Tawi-Tawi under orders of Vice-Admiral Ozawa on 10 June. The force here included six aircraft-carriers shared between two divisions, and these with the rest of the force left the anchorage en route for exercises near the Philippines three days later.

Large as this muster was, it was smaller than the US fleet it encountered, the American strength comprising Task Force 58 with a massive group of eight light carriers and the fleet carriers USS *Bunker Hill*, *Wasp*, *Essex* and *Hornet*, to name only the best-known of a group of seven.

The Japanese admiral made the opening mistake of the day by launching 73 of his aircraft against the US fleet at extreme range. These were the first of 372 flown off, 242 of these being brought down from the four waves that were despatched, in this Battle of the Philippine Sea. The Americans were using in the main Grumman F6F Hellcat fighters, and it was these (together with anti-aircraft guns firing proximity-fused shells) that did the greater part of the morning's execution. US counterattacks were concentrated on the *Shokaku* and *Taiho*. Both had their aviation fuel storage ruptured so that explosive vapours spread throughout the vessels; it was obviously only a matter of time for both, and after delays (in the case of *Taiho* as long as six hours) huge internal explosions tore both apart and sank them. For Japan, the outcome of the meeting of these two carrier groups was in effect the death of her navy.

The years between the attack on Pearl Harbor and this conclusive action had been evolutionary in the use of carrier task forces for the USA. The first US carrier raids had been similar to those mounted by the Royal Navy at the time, and the first attempt to operate two carriers in a single disposition was the attack on New Guinea in March 1942. It was this first combined phase that brought the development of larger carrier task forces, which culminated in such successful operations by the groups already described.

Illustrating the overwhelming might of US naval air power in the last months, the sixth 'Essex' carrier, the USS Ticonderoga *(CV-14) sails for the Far East with Hellcats, Helldivers and Avengers on deck. In her last guise, 'Big T' would be graced with Skyhawks and Crusaders during the Vietnam war.*

JAPAN

Yokosuka D4Y 'Judy'

Well-proportioned and purposeful in appearance, the **Yokosuka D4Y** possessed an excellent performance and owed much of its concept to the German He 118, for whose manufacturing rights Japan negotiated in 1938. Designed as a fast carrier-based attack bomber and powered by an imported Daimler-Benz DB 600G engine, the **D4Y1** was first flown in December 1941; **D4Y1-C** reconnaissance aircraft were ordered into production at Aichi's Nagoya plant, the first of 660 aircraft being completed in the late spring of 1942. The first service aircraft were lost when the *Soryu* was sunk at Midway. Named **Suisei** (comet) in service and codenamed **'Judy'** by the Allies, many D4Y1s were completed as dive-bombers, and 174 Suiseis of the 1st, 2nd and 3rd Koku Sentais were embarked in nine carriers before the Battle of the Philippine Sea. However, they were intercepted by American carriers, and suffered heavy casualties without achieving any success. A new version with 1044-kW (1,400-hp) Aichi Atsuta 32 engine appeared in 1944 as the **D4Y2** but, in the interests of preserving high performance, nothing was done to introduce armour protection for crew or fuel tanks, and the sole improvement in gun armament was the inclusion of a 13.2-mm (0.52-in) trainable gun (replacing the previous 7.92-mm/0.31-in gun) in the rear cockpit. This version suffered heavily in the battle for the Philippines. Problems of reliability with the Atsuta (DB 601) engine led to adoption of a Kinsei 62 radial in the **D4Y3**, and this engine was retained in the **D4Y4** which was developed in 1945 as a single-seat suicide dive-bomber. A total of 2,033 production D4Ys was completed.

Yokosuka D4Y3 of the Imperial Japanese Navy. This version introduced the Mitsubishi MK8P Kinsei 62 radial engine, which avoided the reliability problems of the earlier Aichi Atsuta engine.

Specification
Yokosuka D4Y3 'Judy'
Type: two-seat carrierborne dive-bomber
Powerplant: one 1163.3-kW (1,560-hp) Mitsubishi MK8P Kinsei 62 radial piston engine
Performance: maximum speed 575 km/h (357 mph) at 6050 m (19,849 ft); climb to 3000 m (9,843 ft) 4.55 minutes; service ceiling 10500 m (34,449 ft); range 1520 km (944 miles)
Weights: empty 2501 kg (5,514 lb); maximum take-off 4657 kg (10,267 lb)
Dimensions: span 11.50 m (37 ft 8.75 in); length 10.22 m (33 ft 6.4 in); height 3.74 m (12 ft 3.2 in); wing area 23.60 m² (254.04 sq ft)
Armament: two fixed forward-firing 7.7-mm (0.303-in) Type 97 machine-guns in nose and one 13.1-mm (0.5-in) Type 2 trainable gun in rear cockpit, plus a maximum bombload of 560 kg (1,235 lb)

USA

Curtiss SB2C Helldiver

Curtiss SB2C-1 Helldiver of VB-8 aboard USS Bunker Hill, serving in the Pacific theatre.

Last of a long line of Curtiss aircraft to carry the name **Helldiver** (the earlier aircraft being inter-war biplanes), the **Curtiss SB2C** was first flown as the **XSB2C-1** on 18 December 1940. Production **SB2C-1** aircraft featured an enlarged fin and rudder assembly, increased fuel capacity and four 12.7-mm (0.5-in) guns in the wings. The **SB2C-1C** carried an armament of two 20-mm guns in the wings. The **SB2C-3** appeared in 1944 with more powerful engine, and the **SB2C-4** had provision to carry eight 127-mm (5-in) rockets or 454 kg (1,000 lb) of bombs under the wings (in addition to the 454-kg/1,000-lb internal bombload); the **SB2C-4** carried radar in a small pod under the wing, and the **SB2C-5** had increased fuel. Production amounted to 7,199 of all aircraft, including 300 by Fairchild in Canada, 984 by the Canadian Car and Foundry, and 900 produced for the USAAF as the **A-25A** (most of which were taken over by the US Marine Corps and redesignated **SB2C-1A**). Helldivers first went into action on 11 November 1943 with a raid by VB-17 on Rabaul. During 1944 they gradually replaced the Douglas SBD Dauntless, and were in constant action against the Japanese. Some 26 Canadian-built aircraft were supplied to the UK.

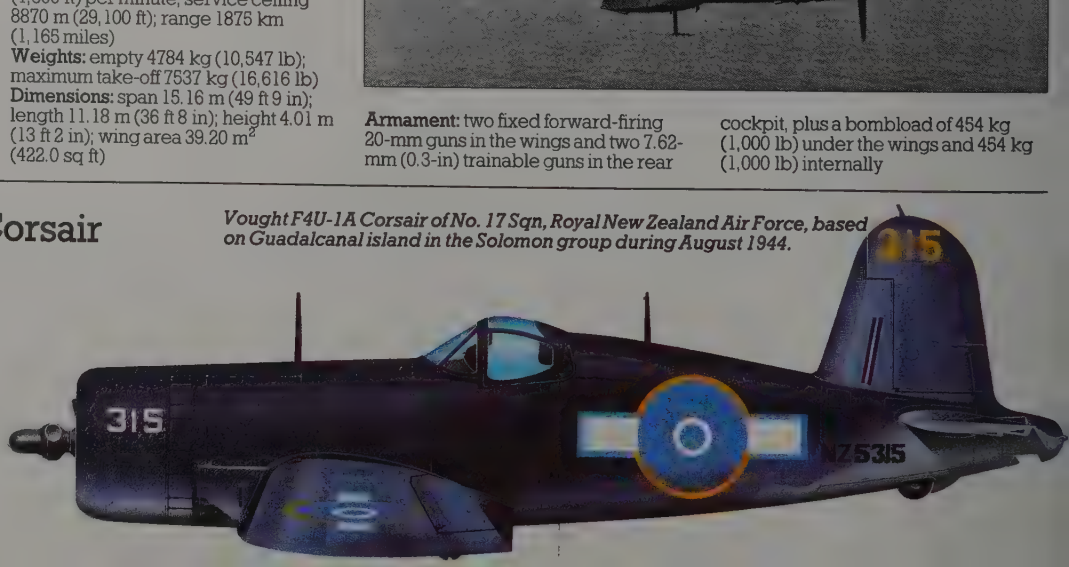
Right: These two SB2C-1C Helldivers from VB-1 are on patrol in 1944. The Helldiver was not liked by pilots or ground crew and was referred to by many derogatory nicknames, the most common of which was 'The Beast'. Despite its reputation, the type put in much service in the thick of the battle against Japan.

Specification
Curtiss SB2C-4 Helldiver
Type: two-seat scout-bomber
Powerplant: one 1416.8-kW (1,900-hp) Wright R-2600-20 radial piston engine
Performance: maximum speed 475 km/h (295 mph) at 5090 m (16,700 ft); initial climb rate 549 m (1,800 ft) per minute; service ceiling 8870 m (29,100 ft); range 1875 km (1,165 miles)
Weights: empty 4784 kg (10,547 lb); maximum take-off 7537 kg (16,616 lb)
Dimensions: span 15.16 m (49 ft 9 in); length 11.18 m (36 ft 8 in); height 4.01 m (13 ft 2 in); wing area 39.20 m² (422.0 sq ft)
Armament: two fixed forward-firing 20-mm guns in the wings and two 7.62-mm (0.3-in) trainable guns in the rear cockpit, plus a bombload of 454 kg (1,000 lb) under the wings and 454 kg (1,000 lb) internally

USA

Vought F4U Corsair

Vought F4U-1A Corsair of No. 17 Sqn, Royal New Zealand Air Force, based on Guadalcanal island in the Solomon group during August 1944.



Distinctive yet not unattractive with its inverted gull wing, the **Vought F4U Corsair** was unquestionably the best shipborne fighter of the war, and gained an 11:1 kill:loss ratio in the Pacific. Designed by Rex B. Beisel, the **XF4U-1** was flown on 29 May 1940, the first production **F4U-1** fighters being delivered to VF-12 in October 1942, although most of the early aircraft went to the US Marine Corps. It was a land-

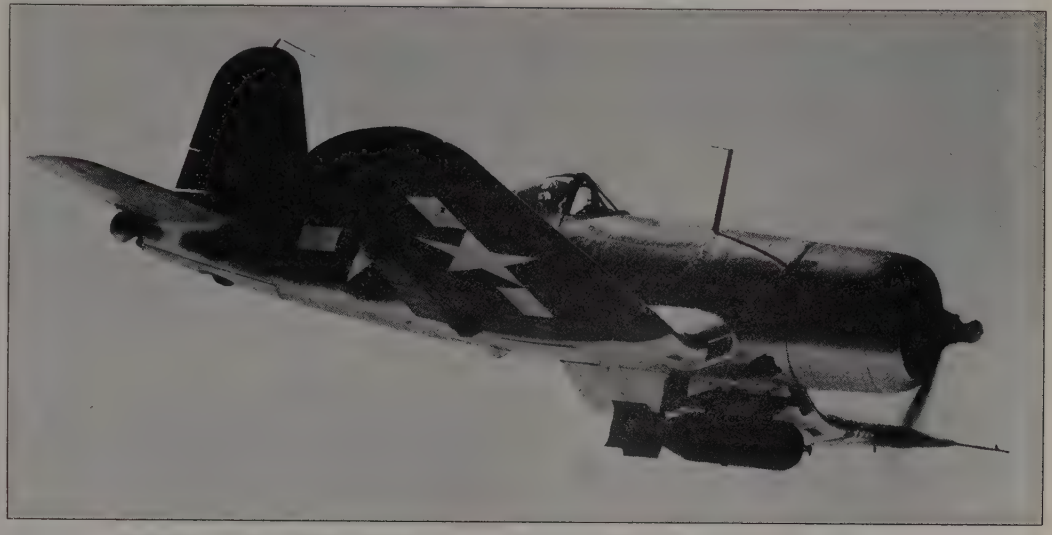
based US Marine squadron, VMF-124, that first flew the Corsair into action, on 13 February 1943 over Bougainville. Additional production lines were set up by Brewster and Goodyear, these companies producing the **F3A-1** and **FG-1** respectively. To improve the pilot's field of view, later aircraft introduced a raised cockpit, and the **F4U-1C** had a four 20-mm cannon armament. The **F4U-1D, FG-1D** and **F3A-1D** were powered by water-injection boosted R-2800-8W engines, and could carry two 454-kg (1,000-lb) bombs or eight 127-mm (5-in) rockets under the wings. Late in the war a night-fighter version, the **XF4U-2**, saw limited service with VFN-75 and VFN-101. Wartime production of the Corsair (which continued until 1952 with later versions) reached 4,120 F4U-1s, 735 F3A-1s and 3,808 FG-1s; of these 2,012 were supplied to the UK's Fleet Air Arm and 370 to New Zealand. Indeed, it was the Royal Navy's **Corsair Mk II** aircraft of No. 1834 Squadron that were the first Corsairs to operate from a carrier when, on 3 April 1944, they took part in operations against the *Tirpitz*.

F4U-1D aboard USS Essex (CV-9) in April 1945, armed with rockets for softening-up attacks on Okinawa.

Goodyear-built Corsair Mk IV (FG-1D) serving with No. 1850 Sqn, Fleet Air Arm, HMS Vengeance, *whilst on Pacific duty in 1945.*

Specification
Vought F4U-1 Corsair
Type: single-seat shipboard fighter
Powerplant: one 1491.4-kW (2,000-hp) Pratt & Whitney R-2800-8 radial piston engine
Performance: maximum speed 671 km/h (417 mph) at 6066 m (19,900 ft); initial climb rate 881 m (2,890 ft) per minute; service ceiling 11247 m (36,900 ft); range 1633 km (1,015 miles)
Weights: empty 4074 kg (8,982 lb); maximum take-off 6350 kg (14,000 lb)
Dimensions: span 12.50 m (41 ft 0 in); length 10.17 m (33 ft 4.5 in); height 4.90 m (16 ft 1 in); wing area 29.17 m^2 (314.0 sq ft)
Armament: six forward-firing 12.7-mm (0.5-in) machine-guns in the wings

The finest naval fighter produced in the war, Vought's distinctive Corsair was also an excellent ground-attack platform with bombs and rockets.



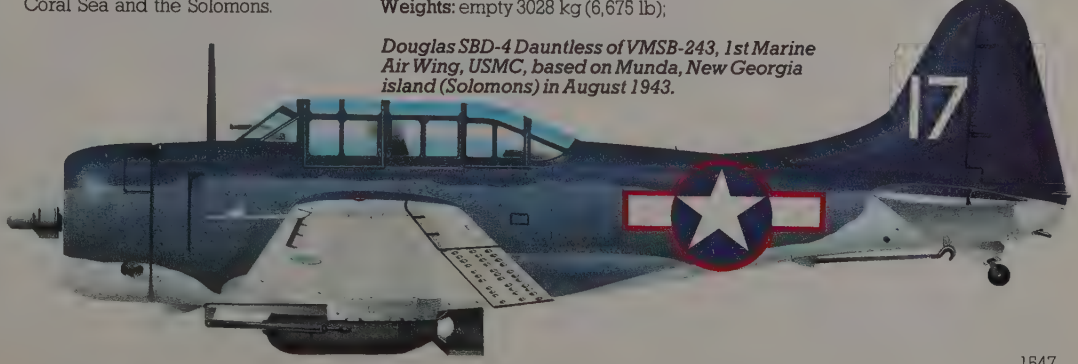
USA

Douglas SBD Dauntless

Developed directly from the **Northrop BT-1** (the Northrop Corporation became a division of Douglas), the prototype of the **Douglas SBD Dauntless** two-seat carrierborne dive bomber was in fact a much modified production BT-1. Production orders for 57 **SBD-1** and 87 **SBD-2** aircraft were placed in April 1939, the former being delivered to US Marine Corps bombing and scout-bombing squadrons, and the latter to US Navy scout and bombing squadrons. The **SBD-3**, with two additional 12.7-mm (0.5-in) guns in the nose, self-sealing tanks and R-1820-52 engine, appeared in March 1941, and by the time of Pearl Harbor in December that year 584 SBD-3s had been delivered. Some 780 **SBD-4** aircraft (with 24-volt electrical system but otherwise as the SBD-3 and produced at El Segundo, California) were built in 1942; photo-reconnaissance modifications (the **SBD-1P, SBD-2P** and **SBD-3P**) were also produced during 1941-2. A new Douglas plant at Tulsa, Oklahoma, built 2,409 **SBD-5** aircraft with 894.8-kW (1,200-hp) R-1820-60 engines, following these with 451 **SBD-6** aircraft with -66 engines. The USAAF took delivery of 168 SBD-3A, 170 SBD-4A and 615 SBD-5A aircraft as the **A-24, A-24A** and **A-24B** respectively, bringing the total Douglas production to 5,936 SBDs. They were unquestionably one of the USA's most important weapons in the Pacific war, and sank a greater tonnage of Japanese shipping than any other aircraft, as well as playing a key part in the great battles of Midway, the Coral Sea and the Solomons.

Specification
Douglas SBD-5 Dauntless
Type: two-crew carrierborne scout/dive-bomber
Powerplant: one 894.8-kW (1,200-hp) Wright R-1820-60 radial piston engine
Performance: maximum speed 394 km/h (245 mph) at 4816 m (15,800 ft); initial climb rate 363 m (1,190 ft) per minute; service ceiling 7407 m (24,300 ft); range 1770 km (1,100 miles)
Weights: empty 3028 kg (6,675 lb); maximum take-off 4924 kg (10,855 lb)
Dimensions: span 12.65 m (41 ft 6.25 in); length 10.06 m (33 ft 0 in); height 3.94 m (12 ft 11 in); wing area 30.19 m^2 (325.0 sq ft)
Armament: two fixed forward-firing 12.7-mm (0.5-in) machine-guns and two trainable 7.62-mm (0.3-in) guns in rear cockpit, plus a bombload of one 726-kg (1,600-lb) bomb under the fuselage and two 147-kg (325-lb) bombs under the wings

Douglas SBD-4 Dauntless of VMSB-243, 1st Marine Air Wing, USMC, based on Munda, New Georgia island (Solomons) in August 1943.



Douglas Dauntless in Action

No aircraft did more to damage the Japanese than the Douglas Dauntless. Its tough frame enabled it to absorb enormous damage whilst delivering an accurate and heavy blow. Together with its brave and highly-skilled pilots, the Dauntless sank ship after ship throughout the Pacific war.

The Douglas SBD Dauntless, or Slow But Dauntless as it was often called, started life as one of the first all-metal low wing monoplane bombers to be built to US Navy specifications. A pre-war design, it was already regarded as obsolescent by the time the United States entered World War II. Nevertheless it succeeded in accounting for most of the damage inflicted during World War II on Japanese carriers, as well as having considerable success against other types of enemy ship. In 1942, it was responsible for sinking more ships than the combined efforts of all other types of US Navy aircraft. Chief designer was Ed Heinemann.

The SBD started life as the Northrop BT-1, which was essentially that company's successful A-17A dive-bomber adapted for carrier operation. The XBT-1 first flew in July 1935, but was not initially a success, a new split-type dive-flap being a particular source of trouble, causing severe buffeting over the tailplane. Following wind-tunnel tests, however, this problem was solved by perforating the dive-flaps, but there were other problems which were thought to be due to it being underpowered with a 700-hp (522-kW) Pratt & Whitney Twin Wasp Junior R-1535-66 engine, later replaced by the 825-hp (615.2-kW) R-1535-94 version.

Development led to the XBT-2, with improved streamlining, fully retracting inward-folding wheels and a 1,000-hp (745.7-kW) Wright Cyclone R-1820-32 engine. This first flew in April 1938, but by that time the Northrop works had become the El Segundo plant of the parent Douglas company, and in consequence the aircraft was restyled the Douglas SBD-1 or Dauntless when ordered into production. An initial contract for 57 machines was placed in April 1939, but the type then failed to meet newly introduced standards for aerodynamic stability. Rigorous flight testing of numerous modifications, including 21 different tail surfaces and 12 different sets of ailerons, led to an improvement, and production recommenced, but the SBD-1 lacked adequate armoured protection for the crew, and had only a limited duration. It was consequently relegated for use by the US Marine Corps, the first to receive the type being Marine Air Group 1 at Quantico, Virginia.

US Navy squadrons received instead the first of 87 SBD-2s, fitted with a 295-litre (65-Imp gal) fuel tank in each of the outer wing panels, to give a range of around 2225 km (1,385 miles). With the ability to make lengthy flights over water, it was also necessary to fit an autopilot. They were followed on the production lines by 584 SBD-3s, of which the first 174 had originally been destined for the Aéronavale. These had the improved 1,000-hp (745.7-kW) Wright Cyclone R-1820-52 engine, armour-plating for the crew, rubber-lined aluminium-alloy self-sealing tanks and a new electrical system. Twin 7.62-mm (0.3-in) trainable guns were fitted in the rear cockpit of later machines. A further 168 machines of this type were produced at the Tulsa plant for the US Army under the designation A-24.

Continued development led to the production of 780 SBD-4s, with various improvements including an electric fuel pump plus an electric emergency fuel pump, a 24-volt electrical system, Westinghouse ASB radar, radio direction finder (DF) gear for overwater navigation, and a constant-speed propeller; 170 more were provided to the US Army as the A-24A, being mostly used for training purposes. Continued development led to the SBD-5, the main production version, of which 3,639 were built, including 615 as the A-24B. This was virtually identical to the SBD-4, fitted instead with the 1,200-hp (894.8-kW) Wright Cyclone R-1820-66 engine, but the extra power was quite inadequate to compensate for the weight of all the extra equipment now being fitted. Nevertheless it saw considerable combat, replacing the earlier versions during 1943.

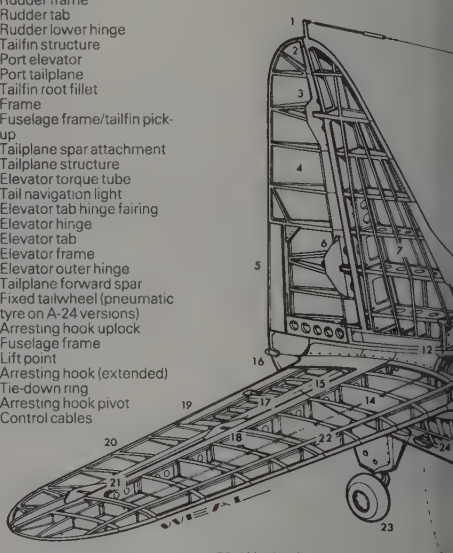
Finally came the SBD-6, of which 451 were built with automatic mixture-control, improved laminated-rubber self-sealing fuel tanks, and external underwing drop tanks. In this latter version it could achieve a range of 1930 km (1,200 miles) whilst carrying a 454-kg (1,000-lb) load of bombs, or 2735 km (1,700 miles) when operating as a scout. Nevertheless its 1,350-hp (1006.7-kW) Wright Cyclone R-1820-66 engine was still unsufficient, and by 1944 the Dauntless was being replaced in carrier service by the Curtiss Helldiver. Nine SBD-5s were supplied to the Royal Navy as the Dauntless Mk I, but were used only for trials. The Royal New Zealand Air Force took over a total of some 68 SBD-3, SBD-4 and SBD-5 aircraft, and some of these saw action in the Solomon Islands.

During the first few weeks after Pearl Harbor, American carriers made isolated raids on Japanese positions, and SBDs were involved in these. Their first really effective use, however, was in the Battle of the Coral Sea on 7 May 1942. This developed when the US Navy moved to prevent a Japanese attempt to occupy Port Moresby in New Guinea. Living up to their nickname, 45 SBDs from the USS *Yorktown* and USS *Lexington* sank the small Japanese carrier *Shoho*, which had commissioned only four months earlier, and followed this up the follow-

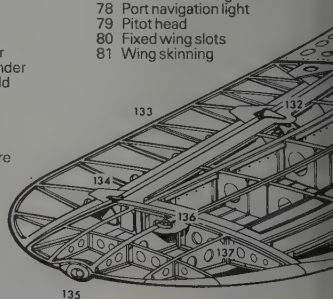
Early Dauntlesses are prepared for a mission. Whilst the Dauntless equipped most of the bombing squadrons early in the war, their stablemate, the TBD Devastator (aft with folded wings), equipped the torpedo squadrons.

Douglas SBD-3 Dauntless cutaway drawing key

1 Aerial stub
2 Rudder balance
3 Rudder upper hinge
4 Rudder frame
5 Rudder tab
6 Rudder lower hinge
7 Tailfin structure
8 Port elevator
9 Port tailplane
10 Tailfin root fillet
11 Frame
12 Fuselage frame/tailfin pick-up
13 Tailplane spar attachment
14 Tailplane structure
15 Elevator torque tube
16 Tail navigation light
17 Elevator tab hinge fairing
18 Elevator hinge
19 Elevator tab
20 Elevator frame
21 Elevator outer hinge
22 Tailplane forward spar
23 Fixed tailwheel (pneumatic tyre on A-24 versions)
24 Arresting hook uplock
25 Fuselage frame
26 Lift point
27 Arresting hook (extended)
28 Tie-down ring
29 Arresting hook pivot
30 Control cables



31 Fuselage structure
32 Bulkhead
33 Section light
34 Radio bay
35 Radio bay access door
36 Wingroot fairing frame
37 Stringers
38 Life-raft cylindrical stowage (access door port side)
39 Dorsal armament stowage
40 Hinged doors
41 Aerial
42 Twin 0.30-in (7.62-mm) Browning machine-guns
43 Gunner's face armour
44 Canopy aft sliding section (open)
45 Gun mounting
46 Ammunition feed
47 Canopy aft sliding section (closed)
48 Ammunition box
49 Oxygen cylinder
50 Oxygen rebreather
51 Oxygen spare cylinder
52 Entry hand/foothold
53 Aft cockpit floor
54 Radio controls
55 Gunner's position
56 Gun mounting
57 Canopy fixed centre section
58 Wind deflector
59 Armoured centre bulkhead
60 Angled support frame
61 Gunner's emergency flight controls
62 Control direct linkage
63 Hydraulics controls
64 Entry hand/foothold
65 Oxygen rebreather
66 Map case
67 Pilot's seat and harness
68 Back armour
69 Catapult headrest
70 Canopy forward sliding section
71 Compass
72 Perforated dive flap
73 Aerial mast
74 Aileron tab
75 Port aileron
76 Aileron tab control linkage
77 Port formation light
78 Port navigation light
79 Pitot head
80 Fixed wing slots
81 Wing skinning



ing day with an attack by 46 machines which achieved three hits on the carrier *Shokaku*, which was lucky to survive. Unfortunately the *Lexington* was herself lost that day.

A month later, the Battle of Midway on 4 June 1942 marked a turning point in the run of Japanese successes in the Pacific. Under the mistaken impression that both the *Lexington* and the *Yorktown* had been sunk in the Coral Sea, the Japanese decided to try to capture Midway Island in the central Pacific and so bring the US Pacific Fleet's forces to decisive battle. Thanks to good intelligence, the *Yorktown* was able to make for the area, supported by the USS *Enterprise* and USS *Hornet*. Early in the battle, 16 US Marine Corps SBDs were sent

This Dauntless is undergoing radio maintenance through a hatch in the fuselage. The aircraft's sieve-like flap/divebrake is clearly visible.

82 Underwing ASB radar antenna (retrofit)
83 Port outer wing fuel tank (55 US gal/208 litre capacity)
84 Aileron control rod
85 Telescopic sight
86 Windscreen
87 Armoured inner panel
88 Instrument panel shroud
89 Two 0.50-in (12.7-mm) machine-guns
90 Control column
91 Switch panel
92 Instrument panel
93 Case ejection chute
94 Ammunition box
95 Engine bearer upper attachment
96 Armoured deflection plate
97 Machine-gun barrel shrouds
98 Engine bearers
99 Oil tank
100 Exhaust slot
101 Oil cooler
102 Cooling gills
103 Exhaust manifold
104 Engine cowling ring
105 Machine-gun troughs
106 Carburettor air intake duct
107 Wright R-1820-52 Cyclone radial engine
108 Three-blade propeller
109 Spinner
110 Propeller hub
111 Port mainwheel
112 Oil cooler intake
113 Exhaust outlet
114 Engine bearers
115 Bomb displacement crutch (in-flight position)
116 Hydraulics vent
117 Case ejection chute outlet
118 Engine bearer lower attachment
119 Starboard mainwheel well
120 Wingroot walkway
121 Starboard/inner wing fuel tank (75 US gal/284 litre capacity)
122 Centre-section dive flap (lower)
123 Wing outer section attachment plate fairing
124 Starboard outer wing fuel tank (55 US gal/208 litre capacity)
125 Mainwheel leg pivot
126 Mainwheel leg door actuation
127 Wing nose ribs
128 Multi-spar wing structure
129 Wing ribs
130 Stiffeners
131 Perforated dive flaps
132 Aileron inner hinge
133 Starboard aileron frame
134 Aileron outer hinge
135 Starboard navigation light
136 Starboard formation light
137 Wingtip structure
138 Fixed wing slots
139 Wing leading-edge
140 Underwing radar antenna (retrofit)
141 Underwing stores pylon
142 100-lb (45.4-kg) bomb
143 Mainwheel leg door
144 Starboard mainwheel
145 Mainwheel axle
146 Mainwheel leg
147 Bomb displacement crutch
148 500-lb (226.8-kg) bomb
149 Aluminium drop tank (58 US gal/219.5 litre capacity)
150 Underwing shackles/fuel line

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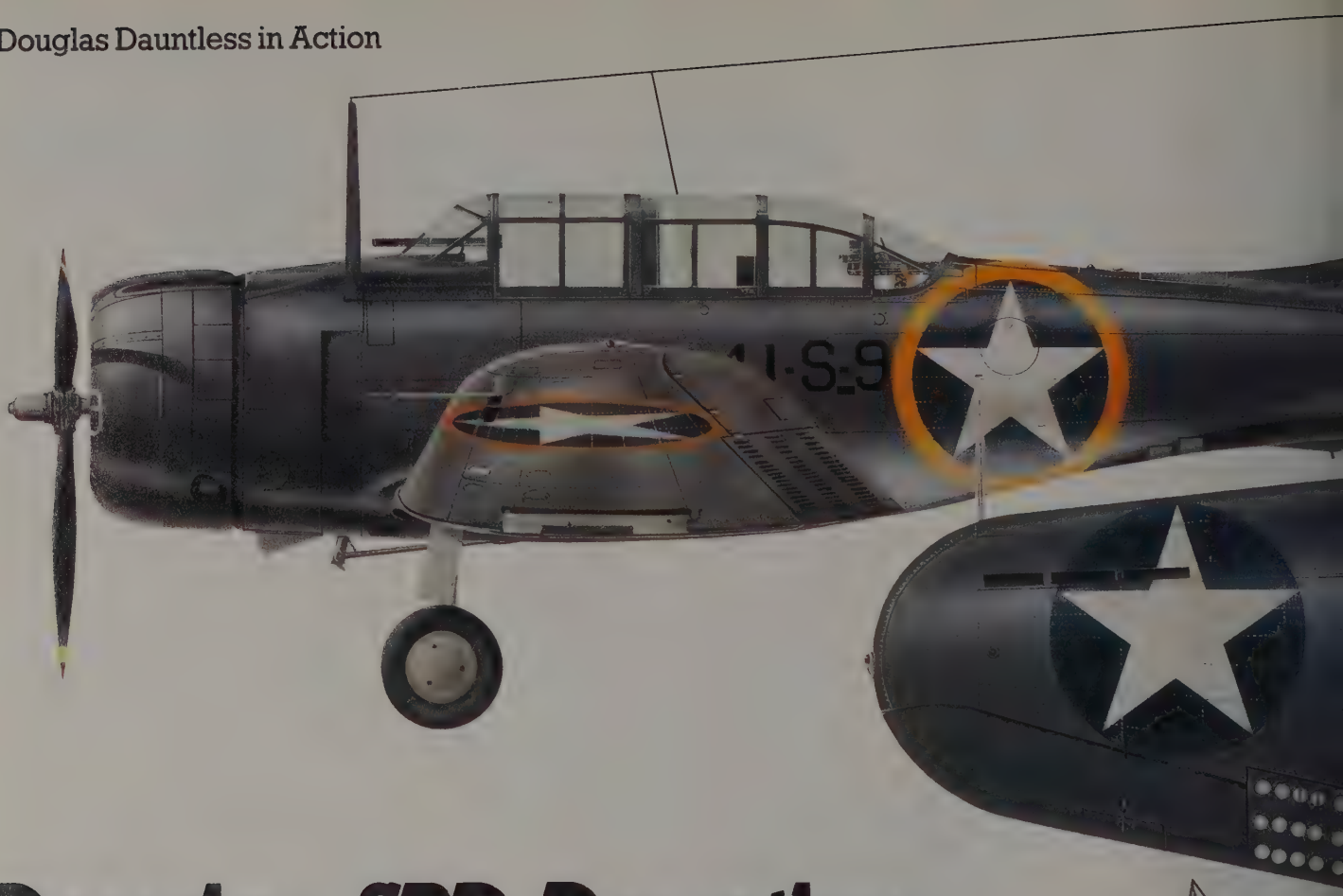
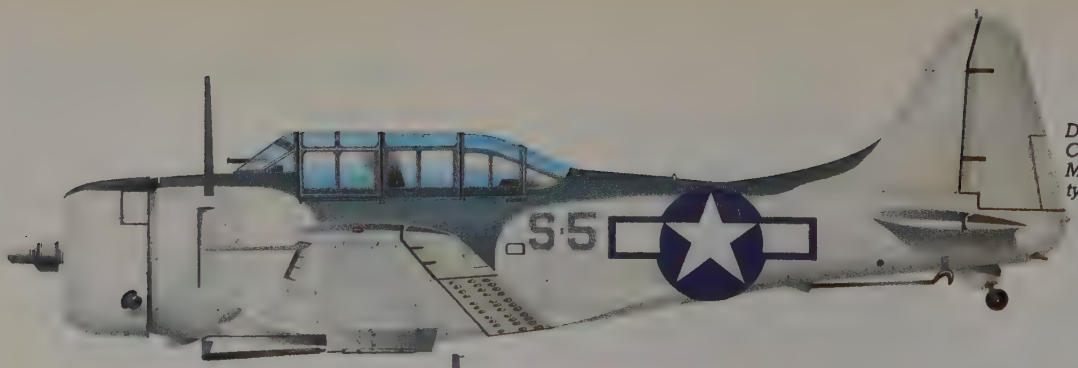
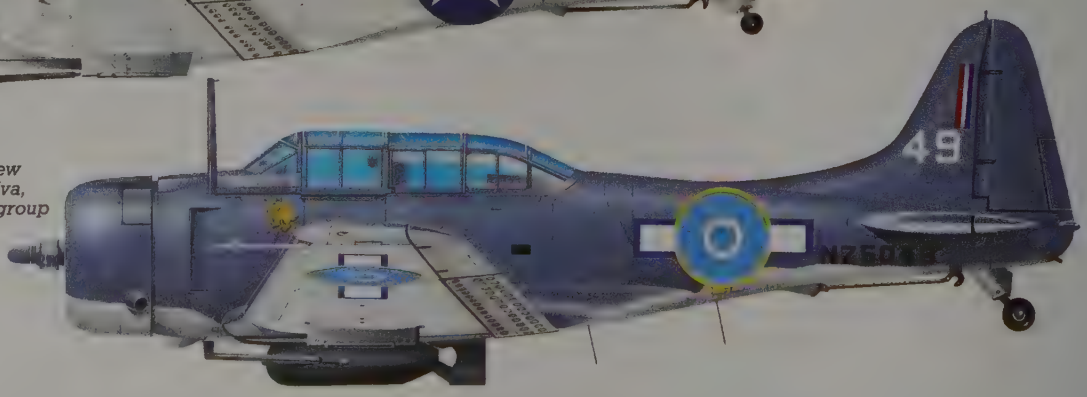


Douglas SBD Dauntless

The Dauntless depicted here is an SBD-3 of Scouting Forty-One (VS-41) which was carried aboard the USS Ranger *(CV-4) during Operation 'Torch', the Allied invasion of North Africa in November 1942. Carrier aircraft played a large part in providing the air cover for these landings, and the Dauntless starred in this role. The yellow border around the national insignia, similar to that used by Commonwealth air forces, was an aid to recognition in this theatre.*



Douglas SBD-5 of VMS-3, US Marine Corps, based in the Caribbean in May 1944. This aircraft displays the typical Atlantic paint scheme.



Douglas SBD-5 of the Royal New Zealand Air Force based at Piva, Bougainville, in the Solomon group during April 1944.

out from Midway Island, but Japanese fighters shot down half of them and drove back the others. Still unaware of the proximity of the American naval force, the Japanese carriers concentrated on preparing for a second strike on Midway. They decimated an attacking force of Douglas TBD Devastators but this left them without fighter protection when 50 SBDs turned up. In a dive-bombing attack which lasted only one minute, the SBDs destroyed the main elements of the Japanese carrier force, leaving behind the burning remains of the *Soryu, Akagi* and *Kaga*, the *Hiryu* being scuttled later as a result of damage. The Japanese withdrew on the following day, abandoning their planned invasion.

The emphasis in the Pacific then moved south to the Solomon Islands, which the Japanese had already occupied and on which they were now busy constructing airfields. In the Battle of the Eastern Solomons, on 24 August, SBDs from the USS *Saratoga* sank the carrier *Ryujo* and scored a hit on the *Shokaku*. Two months later carriers from both sides were heavily involved in the battle for Guadalcanal Island, during which the *Hornet* was lost, but not before her SBDs had inflicted further damage on the *Shokaku*.

Whilst the US Navy's prime concern was the Pacific theatre, it was not entirely absent from activities farther west. During Operation 'Torch', the North African landings in November 1942, SBDs operated from both the USS *Ranger* and USS *Sangamon*. Then in the autumn of 1943 the *Ranger* was lent to the Royal Navy's Home Fleet when HMS *Illustrious* was redeployed to the Mediterranean, and on 4 October its air group, which included 27 SBDs, made a surprise attack on German ships at anchor in Bodo harbour, sinking five and damaging a further five.

Meanwhile the Japanese were being gradually pushed back in the Solomons, but progress was slow, resulting mainly from a shortage of carriers. At the beginning of November 1943, however, American troops went ashore in Bougainville. News then arrived that a fleet of enemy ships was assembling at Rabaul in New Britain, and on the morning of 5 November a strike force of 23 Grumman TBFs and 22 SBDs was sent off from the *Saratoga* and the light carrier USS *Princeton*. The poor weather conditions enabled the aircraft to achieve complete surprise, and they succeeded in inflicting severe damage on four heavy cruisers, as well as hitting two light cruisers and a destroyer, only one of the SBDs being lost.

By this time the Americans had begun to build many new carriers, and on 11 November three of these, the USS *Bunker Hill*, USS *Essex* and USS *Independence* joined in a second attack on Rabaul. SBDs from the *Essex* combined with new Curtiss SB2Cs from the *Bunker Hill* to make a direct hit on a destroyer, causing an explosion that jarred the attacking aircraft as they departed. The escorting fighters inflicted such heavy losses on their Japanese counterparts that the enemy carriers in the area were withdrawn to Truk for six months whilst new pilots were trained.

The SBD had now passed the peak of its career, and from that point the SB2C Helldiver replaced it as the standard US Navy dive-bomber.

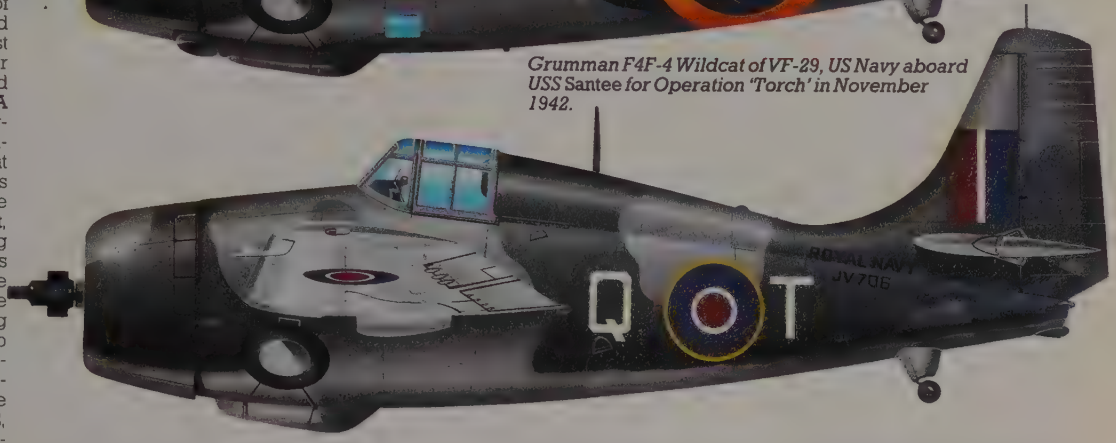
The deck is alive with action as a squadron of Dauntlesses launch on a sortie in the Pacific. The bomb sling can be seen under the fuselage and further bombs under the wings.

USA

Grumman F4F Wildcat

When first flown on 2 September 1937, the **Grumman XF4F-2** single-seat naval fighter prototype proved to be only 16 km/h (10 mph) faster than the Brewster F2A-1, and only when a two-stage supercharged XR-1830-76 was fitted was the true potential of the design recognized, and a speed of 537 km/h (333.5 mph) was recorded during US Navy trials with the **XF4F-3**. Some 54 production **F4F-3** fighters were ordered in August 1939, 22 of which had been delivered by the end of 1940. These aircraft (Grumman's first monoplanes for the US Navy and later named **Wildcat**) served with VF-4 and VF-7, and were followed by 95 **F4F-3A** aircraft with single-stage supercharged R-1830-90 engines. The Wildcat was ordered by France in 1939 but the entire batch of 81 aircraft was transferred to the UK, with whose Royal Navy they served as the **Martlet**, being first flown in combat during 1940. US Navy and US Marine Corps F4Fs were heavily engaged during the early months of the war with the Japanese, numerous aircraft being destroyed on the ground, but also scoring a number of outstanding victories. The **F4F-4**, with manually-folding wings (of which 1,169 were produced), was delivered during 1942, and an unarmed long-range reconnaissance version of this, the **F4F-7**, had a range of over 5633 km (3,500 miles). The F4F-4 was also built by General Motors as the **FM-1**, and a more powerful version, the **FM-2**, for operation from escort carriers. FM-1s and 2s were supplied to the UK as the **Wildcat Mk V** and **Wildcat Mk VI** (the name Martlet having been dropped). F4F-4s were heavily committed in the battles of the Coral Sea and Midway. Total production of the Wildcat (excluding prototypes) was 7,885, including 5,237 FM-1s and FM-2s by General Motors, and 1,100 for the UK.

Grumman F4F-4 Wildcat of VF-29, US Navy aboard USS Santee for Operation 'Torch' in November 1942.



General Motors (Grumman) Wildcat Mk VI (FM-2) of No. 835 Sqn, Fleet Air Arm, aboard HMS Nairana in August 1944.

Although slow and unmanoeuvrable when compared with the Mitsubishi A6M, the Grumman F4F was the best that the US Navy could field in the early days of the war. Flown by highly trained and brave pilots, the Wildcat held its own until more modern aircraft arrived in service.

Specification

Grumman F4F-4 Wildcat

Type: single-seat shipboard fighter

Powerplant: one 894.8-kW (1,200-hp) Pratt & Whitney R-1830-86 radial piston engine

Performance: maximum speed 512 km/h (318 mph) at 5913 m (19,400 ft); initial climb rate 594 m (1,950 ft) per minute; service ceiling 10638 m (34,900 ft); range 1239 km (770 miles)

Weights: empty 2624 kg (5,785 lb); maximum take-off 3607 kg (7,952 lb)

Dimensions: span 11.58 m (38 ft 0 in); length 8.76 m (28 ft 9 in); height 3.61 m (11 ft 10 in); wing area 24.15 m^2 (260.0 sq ft)

Armament: six forward-firing 12.7-mm (0.5-in) machine guns; FM-2 had four guns and provision to carry two 113-kg (250-lb) bombs or six 127-mm (5-in) rockets

USA

Grumman F6F Hellcat

One of America's best wartime shipboard fighters, and ably partnering the F4U Corsair, the **Grumman F6F Hellcat** was the logical development of the F4F Wildcat, and was first flown as the **XF6F-3** on 26 June 1942; this was given an uprated engine and flew again five weeks later. Deliveries to VF-9 aboard USS *Essex* started early in 1943; night-fighter versions were the **F6F-3E** and **F6F-3N** with radar in a wing pod. In 1944 the **F6F-5** appeared with provision for 907 kg (2,000 lb) of bombs and two 20-mm cannon sometimes replacing the inboard wing 12.7-mm (0.5-in) guns: the radar-equipped night-fighter version was the **F6F-5N**; production totalled 6,435 F6F-5Ns, while 252 F6F-3s and 930 F6F-5s served with the British Fleet Air Arm as the **Hellcat Mk I** and **Hellcat Mk II** respectively. Production of all F6Fs amounted to 12,275, and official figures credited the US Navy and Marine Corps aircraft with the destruction of 5,156 enemy aircraft in air combat, about 75 per cent of all the US Navy's air combat victories in the war. The Hellcat's greatest single victory was in that largest of all carrier operations, the Battle of the Philippine Sea, in which 15 American carriers embarked 480 F6F fighters (plus 222 dive-bombers and 199 torpedo-bombers); by the end of a week's fighting Task Force 58 had destroyed more than 400 Japanese aircraft and sunk three carriers. Hellcats were still serving with the US Navy several years after the war.

Grumman Hellcat Mk II of No. 800 Sqn, Fleet Air Arm, flying from HMS Emperor off the coast of Malaya in September 1945. The Fleet Air Arm adopted US-style midnight blue in the Far East and some aircraft sported white bars each side of the national insignia.

Grumman F6F-6 Hellcat of VF-12, US Navy aboard USS Randolph *operating in Japanese waters in early 1945.*

Specification
Grumman F6F-5 Hellcat
Type: single-seat shipboard fighter
Powerplant: one 1491.4-kW (2,000-hp) Pratt & Whitney R-2800-10W radial piston engine
Performance: maximum speed 612 km/h (380 mph) at 7132 m (23,400 ft); initial climb rate 908 m (2,980 ft) per minute; service ceiling 11369 m (37,300 ft); range 1521 km (945 miles)
Weights: empty 4190 kg (9,238 lb); maximum take-off 6991 kg (15,413 lb)
Dimensions: span 13.05 m (42 ft 10 in); length 10.24 m (33 ft 7 in); height 3.99 m (13 ft 1 in); wing area 31.03 m² (334.0 sq ft)
Armament: six 12.7-mm (0.5-in) machine-guns in wings, or two 20-mm cannon and four 12.7-mm (0.5-in) guns in wings, plus provision for two 454-kg (1,000-lb) bombs

The Hellcat finally enabled the Americans to defeat the Mitsubishi A6M. This VD-5 aircraft was used in the photo-reconnaissance role.

USA

Grumman TBF Avenger

Destined to become one of the best shipborne torpedo-bombers of the war, the **Grumman TBF-Avenger** first saw combat during the great Battle of Midway. The **XTBF-1** prototype was first flown on 1 August 1941 after an order for 286 aircraft had already been placed. The first **TBF-1** aircraft appeared in January 1942 and VT-8 ('Torpedo-Eight') received its first aircraft during the following May. On 4 June six of VT-8's aircraft were launched at the height of the Battle of Midway, but only one returned – and this with one dead gunner and the other wounded. Despite this inauspicious start, production was accelerating as General Motors undertook production in addition to Grumman, producing the **TBM-1** version. Sub-variants included the **TBF-1C** with two 20-mm cannon in the wings, the **TBF-1B** which was supplied to the UK under Lend-Lease, the **TBF-1D** and **TBF-1E** with ASV radar, and the **TBF-1L** with a searchlight in the bomb bay. Production of the TBF-1 and TBM-1, as well as sub-variants, were 2,290 and 2,882 respectively. General Motors (Eastern Divison) went on to produce 4,664 **TBM-3** aircraft with R-2600-20 engines, and the sub-variants corresponded with those of the TBF-1s. The UK received 395 TBF-1Bs and 526 TBM-3Bs, and New Zealand 63. The **TBM-3P** camera-equipped aircraft and the **TBM-3H** with search radar were the final wartime versions, although the Avenger went on to serve with the US Navy until 1954.

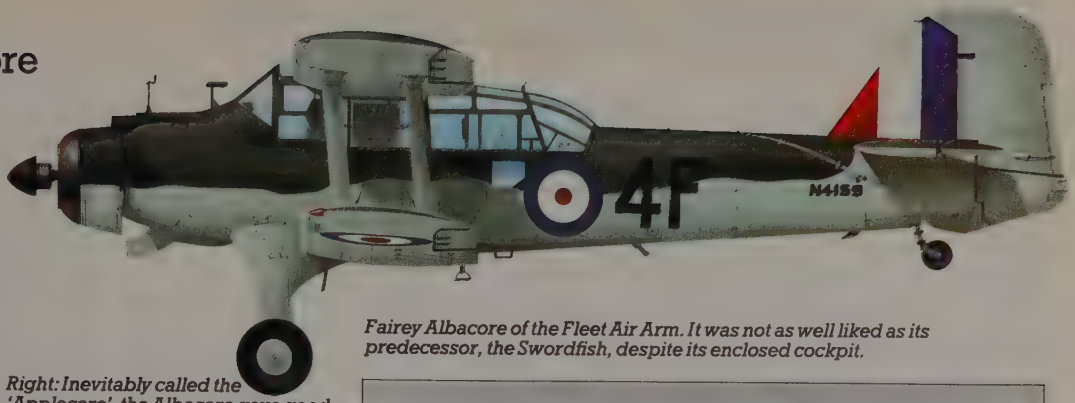
Grumman TBF Avenger of the US Navy. Armament of the dorsal turret was one 0.5-calibre machine-gun.

Specification
Grumman (General Motors) TBM-3E Avenger
Type: three-crew carrierborne torpedo-bomber
Powerplant: one 1416.8-kW (1,900-hp) Wright R-2600-20 radial piston engine
Performance: maximum speed 444 km/h (276 mph) at 5029 m (16,500 ft); initial climb rate 628 m (2,060 ft) per minute; service ceiling 9174 m (30,100 ft); range 1625 km (1,010 miles)
Weights: empty 4783 kg (10,545 lb); maximum take-off 8117 kg (17,895 lb)
Dimensions: span 16.51 m (54 ft 2 in); length 12.48 m (40 ft 11.5 in); height 4.70 m (15 ft 5 in); wing area 45.52 m² (490.0 sq ft)
Armament: two fixed forward-firing 12.7-mm (0.5-in) guns, one 12.7-mm (0.5-in) gun in dorsal turret and one 7.62-mm (0.3-in) gun in ventral position, plus an offensive load of up to 907 kg (2,000 lb) of bombs, or one torpedo, in weapons bay

Avengers replaced the hopelessly outclassed Devastator on the torpedo squadrons from 1942 onwards. These Avengers are seen on a practice torpedo run.

UK

Fairey Albacore



Fairey Albacore of the Fleet Air Arm. It was not as well liked as its predecessor, the Swordfish, despite its enclosed cockpit.

Wholly eclipsed by the Swordfish, which it was intended to replace, the **Fairey Albacore** was in essence a cleaned-up version of the celebrated 'Stringbag' with an enclosed cabin to improve the operational efficiency of the crew and a Bristol Taurus radial to provide higher performance despite considerably greater weights. First flown in December 1938, the initial prototype was fitted with a wheel landing gear, while the second had twin floats. The Albacore, which was inevitably called the 'Applecore' in service, differed from the Swordfish in being used operationally only on the wheeled type of landing gear. The type entered service with the Royal Navy's Fleet Air Arm in 1940, and production amounted to 798 aircraft. The Albacore was first flown in action during attacks on Boulogne in September 1940. Most Albacores were land-based throughout their careers, but the type's brief moment of glory arrived when the Albacores from the carrier HMS *Formidable* severely damaged the Italian battleship *Vittorio Veneto* during the Battle of Cape Matapan in March 1941. After this time the Albacore was occasionally used for bombing in the Western Desert, usually at night to prevent the depredations of Axis fighters, and the type played an important part in the operations leading up to the Battle of Alamein in October 1942. In carrier operations the Albacore saw service in the North Atlantic, Arctic, Mediterranean and Indian oceans; and the type was also used with some success as a support aircraft during seaborne invasions, notably those of Sicily, Italy and northern France, the last in the hands of Royal Canadian Air Force squadrons.

Right: Inevitably called the 'Applecore', the Albacore gave good if undistinguished service, especially in North Africa and the Mediterranean. This aircraft is seen dropping a practice 457-mm (18-in) torpedo.

Specification

Fairey Albacore
Type: three-crew naval torpedo-bomber
Powerplant: one 794.2-kW (1,065-hp) Bristol Taurus II radial piston engine
Performance: maximum speed 259 km/h (161 mph) at 2134 m (7,000 ft); climb to 1829 m (6,000 ft) in 8.0 minutes; service ceiling 6309 m (20,700 ft); range 1320 km (820 miles)
Weights: empty 3266 kg (7,200 lb); maximum take-off 5715 kg (12,600 lb)
Dimensions: span 15.24 m (50 ft 0 in); length 12.13 m (39 ft 9.5 in); height 4.65 m (15 ft 3 in); wing area 57.88 m² (623.0 sq ft
Armament: one forward-firing 7.7-mm (0.303in) Vickers machine-gun and two 7.7-mm (0.303-in) Vickers 'K' machine-guns in the rear cockpit, plus one 457-mm (18-in) torpedo or up to 907 kg (2,000 lb) of bombs

UK

Fairey Barracuda

Intended to replace the Albacore, itself a replacement for the Swordfish, the **Fairey Barracuda** was an altogether more advanced aircraft conceptually, and was designed as a high-performance monoplane to meet a 1937 requirement. The intended powerplant was the Rolls-Royce Exe, and the programme was delayed substantially when this engine was abandoned and the structure had to be revised to accommodate a Merlin engine from the same manufacturer. Thus the Barracuda prototype did not fly until 7 December 1940, and it was immediately apparent that the performance of the heavy Barracuda would be limited by the power available: the 939.6-kW (1,260-hp) Merlin XXX in the **Barracuda Mk I** and the 1222.9-kW (1,640-hp) Merlin 32 for the **Barracuda Mk II** and **Barracuda Mk III**. At a time when production priorities were afforded mostly to the RAF, deliveries of the Barracuda to the Fleet Air Arm were slow to start, and it was January 1943 before Barracuda Mk Is began to enter service with the Fleet Air Arm. The Barracuda Mk I was little more than a service-test type, only 23 being built. The two main wartime models were thus the Barracuda Mk II with ASV Mk IIN radar (1,635 built by Fairey, Blackburn, Boulton Paul and Westland) and the Barracuda Mk III torpedo-reconnaissance version with ASV Mk X radar (912 built by the parent company). The Barracuda saw only limited service in home waters, the highpoint of its career being a highly successful strike on the German battleship *Tirpitz* in April 1944; but in the Pacific campaigns of 1944 and 1945 the Barracuda was one of the more prominent British aircraft.

Fairey Barracuda Mk II of the Fleet Air Arm, complete with anti-submarine radar and underwing depth bombs.

Specification

Fairey Barracuda Mk II
Type: three-crew shipborne torpedo- and dive-bomber
Powerplant: one 1222.9-kW (1,640-hp) Rolls-Royce Merlin 32 V-12 piston engine
Performance: maximum speed 367 km/h (228 mph) at 533 m (1,750 ft); climb to 1524 m (5,000 ft) in 6.0 minutes; service ceiling 5060 m (16,600 ft); range 1851 km (1,150 miles)
Weights: empty 4241 kg (9,350 lb); maximum take-off 6396 kg (14,100 lb)
Dimensions: span 14.99 m (49 ft 2 in); length 12.12 m (39 ft 9 in); height 4.60 m (15 ft 1 in); wing area 34.09 m² (367.0 sq ft)
Armament: two 7.7-mm (0.303-in) Vickers 'K' machine-guns in the rear cockpit, plus one 735-kg (1,620-lb) torpedo, or four 204-kg (450-lb) depth charges, or six 113-kg (250-lb) bombs

Altogether more advanced than the Albacore, the Barracuda was delayed by difficulties with engine-mounting. When it did reach service in January 1943, the aircraft acquitted itself well, especially during the attacks on Tirpitz.

Attacking the Tirpitz

Following the sinking of the* Bismarck*, the British turned their attention to her sister, the* Tirpitz*. It took another three and a half years before she was sunk by RAF Lancasters, but in the meantime she was attacked time and time again by aircraft of the Fleet Air Arm.

The final sinking of the German battleship *Tirpitz* is credited to the RAF's 'Dambusters', the Avro Lancasters of No. 617 Squadron, accompanied by the similarly equipped No. 9 Squadron, who put paid to her in November 1944. It is debatable, however, whether she would have been available to them as a static target had it not been for the earlier efforts of the Fleet Air Arm.

Following the sinking in May 1941 of her sistership *Bismarck*, the *Tirpitz* became the primary headache of the British Admiralty, who feared that she too might break out to raid Atlantic and Arctic convoys. That this fear was well founded was amply demonstrated in March 1942 when she left her refuge in Trondheim whilst convoy PQ.12 was bound from Iceland to the USSR. During the morning of 9 March, a spotting aircraft from HMS *Victorious* sighted the enemy ship, and a strike was mounted by Fairey Albacores of Nos 817 and 832 Squadrons. All succeeded in dropping their torpedoes, but none found the target, and two of the attacking aircraft failed to return. This was destined to be the Fleet Air Arm's first and only chance of finding the *Tirpitz* on the open sea. She made one further foray in July 1942 for an intended attack on the ill-fated convoy PQ.17, but hastily returned to Norway after learning that HMS *Victorious* was once again with the Home Fleet.

The next attack on *Tirpitz* was to have been made at her moorings in Altenfjord early in 1943 by Swordfish from HMS *Dasher*, but that escort carrier blew up near the Isle of Arran on 27 March, many lives being lost. It was not until a year later that a fresh strike could be mounted, but by this time more modern equipment was available in the shape of the Fairey Barracudas of the 9th and 52nd Naval Torpedo Bomber Reconnaissance Wings. Simulated attacks were carried out during March 1944 on a dummy target in Loch Eriboll in north west Scotland; then the wings regrouped their squadrons for the actual attack. HMS *Furious* was to embark Nos 830 and 831 Squadrons with nine aircraft each for the operation, whilst Nos 827 and 829 Squadrons had 12 aircraft each in HMS *Victorious*.

Midget sub attack

The *Tirpitz* had been damaged six months earlier in an attack by midget submarines as she lay at anchor in Kaafjord, but was ready for sea running trials in Altenfjord at the beginning of April 1944. However, by the early morning of 3 April the two fleet carriers were with the Home Fleet Battle Squadron, only 193 km (120 miles) to the north west of the fjord. Accompanying the fleet carriers were the escort carriers HMS *Emperor*, *Fencer*, *Pursuer* and *Searcher*, the first three with two fighter squadrons each, and the last named with a mixed squadron of Fairey Swordfish and Grumman Wildcats for anti-submarine and fighter defence. At 04.24, Operation 'Tungsten' began with the launch of the Barracudas of the 8th TBR Wing, accompanied by an escort of 40 fighters. They arrived at the fjord just as the enemy ship was ready for departure, the escorting Wildcats and Grumman Hellcats appearing over the surrounding hills to machine-gun the target, whilst the Vought Corsairs remained at height in case German fighters should appear. With the element of surprise, all the Barracudas were able to make an attack, and they succeeded in making six direct hits on the stationary target. A further attack an hour later by the other TBR wing was less fortunate, a smoke screen having been laid in the meantime, but nevertheless they claimed a further eight hits as well as some probables. The crews were too weary to carry out a proposed follow-up attack the following day, and this was consequently cancelled.

Further attacks were then planned, but these were dogged by ill luck. A raid on 26 April was cancelled because of poor weather conditions, another on 15 May was recalled after take off as a result of reports of heavy cloud over the target, and bad weather caused yet another cancellation on 28 May. The next effective attack was therefore that carried out on 17 July under the codename Operation 'Mascot'. Nos 827 and 830 Squadrons again participated, but this time from HMS *Formidable*, accompanied by the 9th TBR Wing comprising Nos 820 and 826 Squadrons aboard HMS *Indefatigable*. On this occasion a single strike was carried out, by 44 Barracudas, accompanied by 48 fighters, but the element of surprise was lost when the strike force was spotted from a newly-built mountaintop observation post. This enabled the enemy to lay a dense smoke-

Of all the Fleet Air Arm aircraft used against the* Tirpitz *it was the Fairey Barracuda which bore the brunt of the attack. Barracudas scored many hits on the battleship, effectively crippling it and rendering it immobile for the Lancasters of the RAF to finish it off with 'Tallboys'.

screen, and as a consequence only one near-miss was recorded.

Barracudas were again the main striking force in Operation 'Goodwood' in late August. The *Formidable* carried Nos 826 and 827 Squadrons, while *Furious* had No. 827 Squadron and the *Indefatigable* had No. 820 Squadron, all three ships carrying fighter escort, comprising Corsairs, Supermarine Seafires, Hellcats and Fairey Fireflies. In addition Grumman Avengers and Wildcats were carried in the escort carriers HMS *Nabob* and *Trumpeter*. The first strike ('Goodwood I') on 22 August proved fruitless as a result of further bad weather, and an evening strike by Hellcats ('Goodwood II') was also abortive. The force was reduced that day when the *Nabob* fell victim to an acoustic torpedo launched by *U-354*, though she succeeded in reaching port eventully after struggling more than 1609 km (1,000 miles) in a listing condition.

Displaying its most ungainly lines, extended dive-flaps and strange undercarriage, a Barracuda leaves the catapult. The type in the foreground, the Supermarine Seafire, provided fighter cover (along with Hellcats and Corsairs) for the Barracuda during the attacks on the Tirpitz.

'Goodwood III'

More successful was 'Goodwood III' on 24 April. In this attack each of the 33 participating Barracudas carried a 726-kg (1,600-lb) armour-piercing bomb, whilst some of the Corsairs and Hellcats had 227-kg (500-lb) bombs. Once again the enemy had sufficient warning to put up a smokescreen, but undaunted by this the attackers dived in from various directions to confuse the AA gunners. Despite all the difficulties, one large and one small bomb found their target, but although the former penetrated the armoured decking, it failed to explode. The Fleet Air Arm's best opportunity of disabling or even sinking the ship was thus lost. A final raid on 29 August ('Goodwood IV') was once more frustrated by a smoke screen, and no hits were recorded in the resulting blind attack.

The fate of the *Tirpitz* was finally sealed on 12 November 1944, when RAF Lancasters dropped 28 'Tallboy' bombs, each weighing 5443 kg (12,000 lb). At least two of these scored direct hits, and the ship capsized.

UK

Fairey Firefly

Numbered amongst the most successful aircraft ever used by the Fleet Air Arm, the **Fairey Firefly** served in its various versions for nearly 15 years, a total of 1,702 being produced before production ceased in 1956. The prototype took the air on 22 December 1941, and the first production **Firefly F.Mk I** entered service in March 1943. Later production Mk Is were fitted with ASH radar, in which form they became **Firefly FR.Mk I** reconnaissance fighters. A number of aircraft were produced as **Firefly NF.Mk I** night-fighters equipped with a different radio for night flying, and with shrouded exhausts. Another night-fighter version, the **Firefly NF.MK II**, had AI.Mk X radar mounted on each wing, whilst the **Firefly F.Mk IA** was a modification of the Mk I brought up to FR.Mk I standard by the addition of ASH radar. A trial modification fitted with a Griffon 61 and a nose radiator was designated **Firefly F.Mk 3**, but this was superseded by the **Firefly FR.Mk 4** reconnaissance fighter with a Griffon 74. This went into service in 1946, but from 1948 it gave way to variants of the **Firefly Mk 5** with improved equipment, the surviving FR.Mk 4s being converted to **Firefly TT.Mk 4** target tugs. Then followed the **Firefly AS.Mk 6** anti-submarine reconnaissance and strike aircraft, the final version to enter first-line service, of which 152 were delivered as such, including some converted from Mk 5s on the production line, in addition to many other Mk 5s converted after seeing service. Other versions of the Firefly included trainers and target drones, the last to appear being the **Firefly U.Mk 9** drone in 1956.

The Firefly was an immediate success on entering service, participating in attacks on the German battleship *Tirpitz* as well as taking part in numerous Norwegian raids. It was equally successful in the Pacific, making raids against Japanese occupied islands early in 1945, and against the Japanese mainland shortly before VJ-day. In the post-war years several squadrons took an active part in the Korean War, and one squadron later carried out attacks against Malayan bandits.

Fairey Firefly Mk Is reached squadron service in October 1943, and were soon active against such targets as the Tirpitz. A transfer to the Far East saw more action for the aircraft, but, as with the Fulmar, it was hampered by its size and two-man crew.

Specification

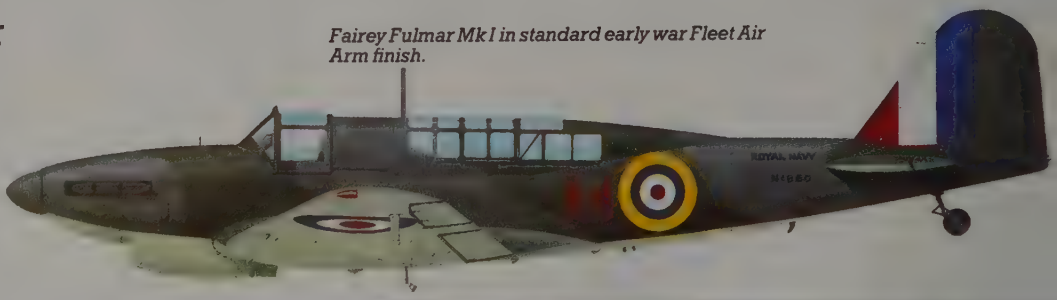
Fairey Firefly F.Mk I
Type: two-seat carrierborne fighter
Powerplant: one 1294-kW (1,735-hp) Rolls-Royce Griffon IIB V-12 piston engine
Performance: maximum speed 509 km/h (316 mph) at 4267 m (14,000 ft); service ceiling 8534 m (28,000 ft); range 2092 km (1,300 miles)
Weights: empty 4423 kg (9,750 lb); maximum take-off 6359 kg (14,020 lb)
Dimensions: span 13.56 m (44 ft 6 in); length 11.46 m (37 ft 7 in); height 4.14 m (13 ft 7 in); wing area 30.47 m² (328.0 sq ft)
Armament: four 20-mm cannon, plus eight 27.2-kg (60-lb) rockets or two 454 (1,000-lb) bombs

UK

Fairey Fulmar

The first true shipborne monoplane fighter for the Fleet Air Arm, the eight-gun **Fairey Fulmar** tends to be overlooked in the part it played in the first three years of the war, until replaced by deck-operating adaptations of the Hurricane and Spitfire, and by the Martlet. Developed from the Fairey P.4/34 light bomber prototypes which flew in 1937, the Fulmar fleet fighter prototype was flown on 4 January 1940, with production aircraft being completed soon after. Early trials showed the aircraft to have a disappointing performance, although it was recognized as being a fairly large aeroplane with the same engine as the Hurricane single-seater. In 1942, after 127 production **Fulmar Mk 1** fighters had been completed, the **Fulmar Mk II** appeared with 939.6-kW (1,260-hp) Merlin XXX, an engine which raised the top speed to 438 km/h (272 mph). Fulmar Mk Is of No. 808 Squadron of the Fleet Air Arm were listed in RAF Fighter Command's order of battle during the Battle of Britain, although they were not engaged in combat. By November 1940, however, Fulmars were in action from HMS *Illustrious* at the time of the Battle of Taranto, and soon afterwards from *Ark Royal* defending the vital convoys sailing to Malta. At the Battle of Cape Matapan Fulmars from *Formidable* escorted the Albacores and Swordfish which torpedoed the Italian battleship *Vittorio Veneto*. Early in 1942, as Japanese naval forces sailed into the Indian Ocean to threaten Ceylon, two squadrons of Fulmars were based there as part of Colombo's air defences; when confronted for the first time by the much superior carrierbased Mitsubishi A6M fighters the Fulmars were utterly outclassed and almost all were shot down or damaged. A total of 450 Fulmar Mk IIs was built, and some served as night-fighters.

Fairey Fulmar Mk I in standard early war Fleet Air Arm finish.



Right: Although powered by the same Merlin engine as the Hurricane and Spitfire, the Fulmar was considerably larger and carried an extra crew member. It was not the equal of the best enemy fighters, but gave a good account of itself.

Specification

Fairey Fulmar Mk II
Type: two-seat carrierborne fighter
Powerplant: one 939.6-kW (1,260-hp) Rolls-Royce Merlin XXX V-12 piston engine
Performance: maximum speed 438 km/h (272 mph) at 5029 m (16,500 ft); initial climb rate 402 m (1,320 ft) per minute; service ceiling 8291 m (27,200 ft); range 1255 km (780 miles)
Weights: empty 3349 kg (7,384 lb); maximum take-off 4627 kg (10,200 lb)
Dimensions: span 14.14 m (46 ft 4.5 in); length 12.24 m (40 ft 2 in); height 3.25 m (10 ft 8 in); wing area 31.77 m² (342.0 sq ft)
Armament: eight 7.7-mm (0.303-in) machine-guns in wings, and a few aircraft also had a single trainable 7.7-mm (0.303-in) machine-gun in the rear cockpit

UK

Fairey Swordfish

Of all aircraft regarded as anachronisms the **Fairey Swordfish** torpedo-bomber must be the supreme example, for even back in the 1930s it appeared archaic and cumbersome. Stemming from an earlier design whose prototype had crashed, the first prototype Swordfish (the **TSR.II**) first flew on 17 April 1934 and the production **Swordfish Mk I** was prepared to Specification S.38/34 with slightly swept-back top wing; construction was all-metal with fabric covering. By the outbreak of war in 1939 a total of 689 aircraft had been delivered or were on

A Fairey Swordfish Mk II is 'struck down' following an anti-submarine patrol.

Throughout the later months of the war, Swordfish were used on general attacks against German shipping in the North Sea. These were often small vessels and their light defences proved inadequate against the tough Swordfish. Rockets were the favoured weapon for these strikes.

Fairey Swordfish Mk I of No. 820 Sqn serving aboard HMS Ark Royal *in 1939. This aircraft is carrying the standard 457-mm (18-in) torpedo.*

Fairey Swordfish Mk II of No. 811 Sqn aboard HMS Biter *in 1944, complete with invasion stripes.*

order, serving with both wheel and float landing gear aboard Royal Navy carriers, battleships, battle-cruisers and cruisers in the torpedo-spotter reconnaissance role. Among the memorable events in which the old 'Stringbag'

Seemingly an anachronism in World War II, the Swordfish remained unmatched by any other British naval aircraft in terms of battle honours. At the heart of this was the aircraft's immense sturdiness and basic good design. This typically well-worn example is carrying a practice bomb.

participated was the action at Taranto on 11 November 1940, when Swordfish aircraft from HMS *Illustrious* severely damaged three Italian battleships; the crippling of the *Bismarck* in the Atlantic; and the suicidal attack on the German warships, *Scharnhorst, Gneisenau* and *Prinz Eugen* during their famous escape up the English Channel in February 1942. Production of the Swordfish was undertaken largely by Blackburn, the **Swordfish Mk II** being introduced with a strengthened lower wing to allow eight rocket projectiles to be mounted, the **Swordfish Mk III** with ASV radar between the landing legs, and the **Swordfish Mk IV** conversion of the Mk II with a rudimentary enclosed cabin. Production ended on 18 August 1944, by which time a total of 2,396 Swordfish had been completed.

Specification

Fairey Swordfish Mk II

Type: three-crew torpedo/anti-submarine aircraft

Powerplant: one 559.3-kW (750-hp) Bristol Pegasus XXX radial piston engine

Performance: maximum speed 222 km/h (138 mph) at sea level; initial climb rate 372 m (1,220 ft) per minute; service ceiling 5867 m (19,250 ft); range 879 km (546 miles)

Weights: empty 2132 kg (4,700 lb); maximum take-off 3406 kg (7,510 lb)

Dimensions: span 12.87 m (45 ft 6 in); length 10.87 m (35 ft 8 in); height 3.76 m (12 ft 4 in); wing area 56.39 m^2 (607.0 sq ft)

Armament: one fixed forward-firing 7.7-mm (0.303-in) machine-gun and one trainable 7.7-mm (0.303-in) gun in rear cockpit, plus an offensive load of one 457-mm (18-in) torpedo or eight 27.2-kg (60-lb) rocket projectiles

UK

Hawker Sea Hurricane

Based on the RAF's Hurricane, the **Hawker Sea Hurricane** was introduced to provide modern fighter protection for convoys of merchant ships. Over 800 were delivered, the majority of them being conversions of Hurricanes, including many which had seen operational service. A number were modifications of newly delivered Canadian-built aircraft.

The first version to appear was the **Sea Hurricane Mk IA** fitted with catapult spools so that they could be flown from specially fitted merchant ships in the event of the appearance of an enemy aircraft. This was followed by the **Sea Hurricane Mk IB**, which in addition to the spools had deck arrester gear to enable it to be used for carrier operations. The **Sea Hurricane Mk IC**, of which only a few were produced, had four wing-mounted 20-mm cannon in place of the machine-guns of the earlier versions. Re-engined with the Rolls-Royce Merlin XX it became the **Sea Hurricane Mk IIB** when fitted with machine-guns, and the **Sea Hurricane Mk IIC** with cannon. Canadian-built aircraft also used these designations, irrespective of their original mark numbers.

Sea Hurricanes first entered operational service in February 1941 with No. 804 Squadron for deployment from catapult-armed merchantmen, or CAM-ships as they were generally known. The first carrier squadron to equip was No. 880 Squadron in March 1941, seeing action in July from HMS *Furious* during a raid on the Arctic port of Petsamo. The following month an aircraft of No. 804 Squadron catapulted from HMS *Maplin* accounted for a Focke-Wulf Condor. The disadvantage of this method of operation was that unless the pilot could reach land he had no choice but to ditch his aircraft. The CAM-ship task and aircraft were later passed on to the RAF's Merchant Ship Fighter Unit at Speke. When the first escort carriers came into service with the Royal Navy, Sea Hurricanes were attached to several of them, seeing service in the Arctic and the Mediterranean until being replaced in 1943 by Seafires and Wildcats.

Specification

Hawker Sea Hurricane Mk IIC
Type: carrierborne fighter
Powerplant: one 954.5-kW (1,280-hp) Rolls-Royce Merlin XX V-12 piston engine
Performance: maximum speed 505 km/h (314 mph) at 5944 m (19,500 ft); service ceiling 10516 m (34,500 ft); range 1207 km (750 miles)
Weights: empty 2617 kg (5,770 lb); maximum take-off 3511 kg (7,740 lb)
Dimensions: span 12.20 m (40 ft 0 in); length 9.83 m (32 ft 3 in); height 4.00 m (13 ft 1.5 in); wing area 23.92 m² (257.5 sq ft)
Armament: four 20-mm cannon

After the failure of such types as the Sea Gladiator and Fulmar to provide adequate fighter protection, the Hurricane was hastily adapted for carrier decks. The result was a fine fighter which saw much action.

UK

Supermarine Seafire

Following the success of the Sea Hurricane adaptation, a Spitfire VB was fitted with a 'V' arrester hook and satisfactory trials were carried out in HMS *Illustrious* towards the end of 1941. A number of these aircraft with 'B' type wings were similarly modified and named **Supermarine Seafire Mk IB**. In May 1942 the **Seafire Mk IIC** began to come off the production line, fitted with the 'C' type Spitfire wing with provision for four 20-mm cannon, and having a reinforced fuselage, catapult spools and rocket-assisted take-off gear (RATOG). A low-altitude version was the **Seafire L.Mk IIC**, and a few were fitted with cameras for photographic reconnaissance work, being designated **Seafire LR.Mk IIC**. A manually-operated folding wing was introduced on the **Seafire F.Mk III**, and as with the earlier mark there was a **Seafire L.Mk III** variant for low-altitude work, a few being modified as the **Seafire LR.MK III** for photo-reconnaissance duties.

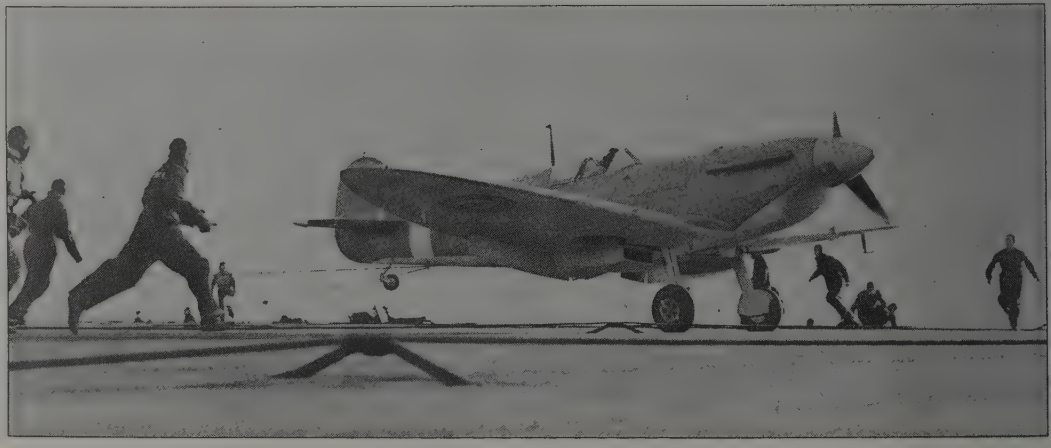
In 1945 the Griffon-engined Seafire **F.Mk XV** appeared, with a sting-type arrester hook, being followed by the **Seafire F.Mk XVII** with a clear-view bubble hood, cutaway rear fuselage and increased fuel capacity. The **Seafire FR.Mk XVII** reconnaissance variant had two cameras. Based on the Spitfire F.Mk 21, the **Seafire F.Mk 45** had a later Griffon fitted with either a five-blade propeller or two three-blade counter-rotating propellers. The clear-view bubble hood and cutaway rear fuselage were fitted to the **Seafire F.Mk 46**, a reconnaissance version being the **Seafire FR.Mk 46**. The final version, the **Seafire F.Mk 47**, and the **Seafire FR.Mk 47** variant, had power-folding wings and other changes.

The Seafire participated successfully in the North African landings in November 1942, and later at Salerno and the south of France. Its principle failing was highlighted at Salerno, where lack of windspeed over the carrier decks led to numerous collapsed landing gears. Several squadrons were active in the Pacific, and after the war the Griffon-engined versions remained in service until 1954, many with reserve squadrons.

Specification

Supermarine Seafire F.Mk III
Type: carrierborne fighter
Powerplant: one 1096-kW (1,470-hp) Rolls-Royce Merlin 45, 50 or 55 V-12 piston engine
Performance: maximum speed 566 km/h (352 mph) at 3734 m (12,250 ft); service ceiling 10302 m (33,800 ft); range 748 km (465 miles) on internal fuel
Weights: empty 2449 kg (5,400 lb); maximum take-off 3175 kg (7,000 lb)
Dimensions: span 11.23 m (36 ft 10 in); length 9.12 m (29 ft 11 in); height 3.48 m (11 ft 5 in); wing area 22.48 m² (242.0 sq ft)
Armament: two 20-mm cannon and four 7.7-mm (0.303-in) machine-guns, plus provision for one 227-kg (500-lb) bomb or two 113-kg (250-lb) bombs

Seafires were potent fighters with high performance for a deck-launched aircraft but suffered a great deal from weak undercarriages and relatively high landing speed.



Royal Navy Part 1

The Royal Navy currently has worldwide capabilities, but because of political commitments concentrates its main strength in support of NATO's Eastern Atlantic (EASTLANT) area of operations. In the last couple of years, however, this support has been diluted by the need to maintain a task group (with an SSN in support) in the South Atlantic to protect the Falkland Islands from any further Argentine aggression. Moreover, the Royal Navy is still suffering from the effects of the ill-conceived 1981 Defence Review and the salutary lessons dealt to it during the 1982 war by the Argentine air force and naval air arm. The closure of one naval dockyard and the reduction of another to fleet maintenance base status has placed considerable strain on the Royal Navy's support infrastructure for the refitting of warships and auxiliaries, which has resulted in a number of vessels now being refitted in commercial yards. Unfortunately this makes such ships much more vulnerable to external influences (such as strikes), which compounds the problems yet further. The slow but sure orientation of the Royal Navy to counter the Soviet ASW (anti-submarine warfare) threat whilst maintaining the minimum credible nuclear deterrent force of SLBM (submarine-launched ballistic missile) submarines is also reducing the Royal Navy's capabilities, and the overall reduction of surface ship numbers also testifies to this tendency.

However, to fulfil the peacetime and wartime roles assigned to it, the Royal Navy has evolved over many years a command structure that is geared to the flexibility needed to carry out such tasks. The surface fleet of destroyers and frigates is divided into two flotillas each commanded by a flag officer. At present the Flag Officer Flotilla One (FOF1) flies his flag in a 'County' class destroyer and has under his command the 3rd Destroyer Squadron with the 1st, 6th and 7th Frigate Squadrons, whilst FOF2 flies his flag in the other 'County' class destroyer available and has the 5th Destroyer and the 2nd, 4th and 8th Frigate Squadrons available. The major surface combatants of the Royal Navy and the sole ice patrol ship HMS *Endurance*, together with most of the naval air assets afloat, is the concern of FOF3, who is also commander of NATO's ASW Group Two in wartime, with the prime responsibility of protecting the US carrier battle group formations of NATO's Strike Fleet in their forays into the northern flank area.

Independent of the FOFs is the Flag Officer Submarines (FOSM), who exercises on behalf of the Commander-in-Chief Fleet (CINCFLEET) the operational command and tasking of all the subsurface craft bar the 10th Submarine Squadron of SSBNs during their operational cycle. These remain exclusively under CINCFLEET control whilst on patrol. FOSM has under his command the 1st Submarine Squadron of conventional boats at Portsmouth, the 2nd Submarine Squadron of fleet submarines at Devonport and the 3rd Submarine Squadron (a mixture of boats) at Faslane. The problem of mine countermeasures is addressed by the 1st, 2nd, 3rd and 10th (RNR) Squadrons of the Mine Countermeasures Flotilla, with the individual units assigned to the flag officers of the various naval operational zones within the United Kingdom region.

Seen in the Clyde estuary with the nuclear-powered fleet submarine HMS Churchill, *the nuclear-powered ballistic missile submarine HMS* Renown *is armed with 16 Polaris A3 missiles, each with three 60-kiloton 'Chevaline' warheads. The Polaris system will be replaced by Trident during the 1990s.*

Submarines and major surface vessels

At present the deterrent force of the UK devolves upon the continuous presence of one or more of the 'Resolution' class SSBNs (strategic missile submarines, nuclear-powered) on submerged patrol. Armed with the Polaris A3 missile with three 60-kiloton 'Chevaline' warheads with advanced decoys and penetration aids to defeat Soviet ABM defences, each submarine can engage up to 16 separate targets at ranges up to 4627 km (2,875 miles) with a high kill probability. To enhance the deterrent into the 21st century the first of a class of four 'V' class Trident SSBNs will commission in 1994 to replace the Polaris boats on a one for one basis. Armed with 16 Trident D5 missiles, each carrying eight independently targeted 100-kiloton yield warheads over 9600-km (5,965-mile) range, these new SSBNs will be protected by a growing force of fleet SSNs (attack submarines, nuclear-powered). The oldest boats in the force are five 'Valiant' and 'Churchill' class vessels, which are backed up by six modern 'Swiftsure' class boats and a growing number of the anechoic sound-absorbing tile-coated 'Trafalgar' class SSNs. They are armed with the 22-km (13.7-mile) range 35-kt Mk 24 Model 1 Tigerfish dual ASW/anti-ship wire-guided torpedo, together with Mk 8 anti-ship torpedoes and Sub-Harpoon underwater-launched sea-skimming anti-ship missiles. In the late 1980s the Tigerfish will be supplemented by the new 60+ kt Spearfish heavyweight dual-role torpedo and a new long-range underwater-launched guided ASW missile that will carry a Stingray lightweight torpedo derivative as its payload.

HMS Invincible, *the first of her class of VTOL aircraft carriers, leaves port during a visit to the United States. The newly-installed Phalanx 20-mm Close-in Weapon System is prominent in its position on the flight deck.*

To support the fleet submarines in their operations and to provide a submarine force capable of operating effectively in the continental-shelf and coastal-sea areas where the SSNs are at a disadvantage, the Royal Navy has 13 'Oberon' and two 'Porpoise' class conventional diesel-powered boats. These are to be replaced from the late 1980s onwards by 10-12 'Upholder' class vessels based on the Vickers Type 2400 design. These boats will combine the shape, internal arrangement and sensor capability of the SSN with a new quieter conventional submarine propulsion plant and battery. Apart from their normal operational roles, both the conventional submarine types provide a method of inserting covert SAS units into enemy territory without being detected, as they demonstrated during the Falklands war when they landed numerous reconnaissance teams all round the Falkland Islands.

The conventional boats and to a certain extent the SSNs are also tasked with the Royal Navy's offensive minelaying operations during wartime. Unfortunately the mines they carry for this, the Mk 5 ground and the Mk 6 buoyant, are of World War II vintage and have long since become obsolete. However, families of new modular ground mines are available in the UK but the Ministry of Defence (MoD) has shown no interest save in saying that new actuator systems will be procured for the old mine stocks. This reliance on obsolete weapons for the submarine service is not new, especially when it is realized that the Mk 8 Model 4 torpedo in use today, and which sank the Argentine cruiser *General Belgrano*, was in fact originally designed in the mid-1920s, some 60 years ago. In terms of training and other equipment, the submarine service is among the world's best and very often proves itself so against other NATO navies in exercises.

In 1966 the Royal Navy was told that its fixed-wing aircraft strength was to be scrapped. Over a period (and using various subterfuges to get around political and Treasury objections) the three-ship 'Invincible' class of light aircraft-carrier was evolved to carry the BAe Sea Harrier V/STOL fighter-bomber. Carrying an air group of six V/STOL jets and 9-12 Westland Sea King anti-submarine and AEW (airborne early-warning) helicopters, these ships are designed for the ASW role. They also carry limited stocks of nuclear depth bombs and tactical free-fall gravity bombs in their magazines. To complement these they also have a wide range of conventional ASW, air-to-surface and air-to-air stores for a conventional conflict. However, in a carrier-to-carrier engagement such as that with a Soviet 'Kiev' class VTOL or 'Kremlin' class conventional fixed-wing carrier, the small number of Sea Harriers carried would not be enough. The only carrier that the Royal Navy has available to embark a significant number of aircraft, HMS *Hermes*, is considered manpower-intensive and is now languishing alongside at Portsmouth as a training vessel before going to scrap when HMS *Ark Royal*, the third 'Invincible', commissions.

A laden utility landing craft (LCU) is manoeuvred within the docking well of the amphibious assault ship HMS* Intrepid. *With HMS* Fearless, Intrepid *provides almost all the Royal Navy's amphibious capability.

The two LPDs (amphibious transport docks), HMS *Fearless* and HMS *Intrepid*, form the major component of the amphibious warfare forces, and were the prime instruments of British ability to retake the Falklands; without their specialized equipment an amphibious landing would have been impossible. There is, however, a need in the next year or so to order replacements if the continued policy of being able to project the Royal Marines on amphibious operations throughout the world is to be maintained. Although the MoD is apparently looking at the situation as part of a study, it is probable that any positive attitude displayed will only result in an order placed too late to provide any continuity.

The other major surface ships are the large destroyers HMS *Bristol*, HMS *Fife* and HMS *Glamorgan*, which were to have been deleted prematurely under the 1982 Defence Review findings. But because of the Falklands reappraisal and the fact that all three units offer extensive flagship facilities not found in any other surface ships save the carriers and LPDs, all three will serve on into the early 1990s. The *Bristol* is especially useful to the Navy as she is one of the few RN flagships that has the necessary data links to communicate directly with US Navy and French navy action information systems. It is possible that the vessels will eventually be superseded by the Type 22 Batch 3 frigates or a Sea Dart-armed derivative of this type.

HMS* Bristol *was to have been the first of a class designed to escort the abortive CVA-01 fleet carrier project, but no other 'Type 82' was built. The vessel has found a use as a flagship, her large size allowing comprehensive command and control facilities.

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Modern 1.5 to 5 Ton Trucks

This ENGESA EE-25 2500-kg (5,511lb) 6×6 truck shows flexibility of its rear bogies during cross-country operations. The EE-25 can be built with a hydraulic crane for unloading stores, with a front, centre or rear mounted winch, power take-off, and engine-start device for use in cold weather.

Today's mechanized armies require more logistic support than ever before, and if the flow of supplies stops the army itself will soon grind to a halt. Medium trucks bear the greatest share of this burden and must carry their loads in all weathers over rough terrain and into the battle area itself.

Every army needs a massive number of trucks, not only to carry troops and tow artillery weapons, but also to keep all units provided with the fuel, water, food, ammunition and spare parts they need for their mission. For many years after World War II the 2.5/3-ton truck was the most usual vehicle of this type to be found in most armies, but today it is the 4/5-ton type that is more common.

Some current trucks have been built specifically to meet the requirements of the military, such as the American M35 2.5-ton 6×6 vehicle, but the trend in recent years has been to produce vehicles that at the very least share their major automotive parts (for example engine, transmission, brakes, suspension and cab) with trucks already in volume production for civil applications. Other military trucks are essentially standard commercial vehicles with minimum modifications to suit them for military use, typical features being larger tyres and wheels for greater ground clearance, all-wheel drive for improved cross-country mobility, and a military type rear cargo body. Petrol engines have given way to diesel units, which are considerably more fuel efficient as well as being less likely to catch fire. Many military trucks are fitted with hydraulic cranes to enable cargo to be loaded and unloaded rapidly without any outside assistance, and in many armies cargo is loaded on to pallets for easier handling in the field.

Since the 1950s many countries such as Brazil and Spain have been building up their automotive capabilities, and these nations are now exporters of military vehicles to many parts of the world. Often the same manufacturer is able to supply a complete range of armoured vehicles and military trucks to a foreign army with obvious logistic, economic and training advantages to the operator.

In addition to carrying cargo, trucks are used for a wide range of other roles such as command, field repair, recovery, RPV transport and launch, and mounting weapons systems such as multiple rocket launchers. There is little doubt that if there were no trucks then the most sophisticated army would soon grind to a halt.

One of the West German MAN range of 4×4, 6×6 and 8×8 vehicles is put through its paces. These are all known as Category 1 vehicles and are probably the best trucks of their type in the world. The 8×8 model is used to tow American Pershing and ground-launched cruise missiles.

BRAZIL

ENGESA EE-25 2500-kg 6×6 truck

In recent years the ENGESA company has progressed from converting 4×2 and 6×4 vehicles into all-wheel drive vehicles to the design and production of a complete family of wheeled armoured fighting vehicles and trucks. The former include the EE-3 Jararaca 4×4 scout car, the EE-9 Cascavel 6×6 armoured car and the EE-11 6×6 armoured personnel carrier, total sales of these reaching some 4,000 units by 1984. The company's range of trucks includes the **ENGESA EE-15** 4×4, **EE-25** 6×6 and new **EE-50** 6×6 vehicles, all of which are already used by the Brazilian army in addition to countries in South America and the Middle East. The EE in the designation stands for the company name, Engenheiros Especializados, while the digits represent the cross-country carrying capacity of the vehicle: for example, the EE-15 can carry 1.5 tonnes, while the EE-50 can carry 5 tonnes.

The EE-25 6×6 truck has been designed to carry 5000 kg (11,023 lb) of cargo on roads or 2500 kg (5,512 lb) of cargo across country, and is similar in appearance to the standard American 2.5-ton 6×6 trucks, with the engine at the front, three-man cab in the centre, and the cargo area at the rear. The Mercedes-Benz OM-352A diesel is also used in some versions of the EE-9 and EE-11 armoured vehicles, and is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. Steering is power-assisted on the front wheels, and 11.00×20 tyres are fitted all round. The front suspension consists of semi-elliptical springs with hydraulic double-acting shock absorbers, while the rear suspension is of the famous ENGESA Boomerang type with semi-elliptical springs, the whole suspension giving exceptional cross-country mobility compared with that of other vehicles of this type. The rear suspension can have single or dual wheels.

The cab has a vinyl top and doors, which facilitates the air transport of the vehicle, while the rear cargo area has a drop tailgate, bows which can be stowed to the cab rear when not needed, and a tarpaulin cover. If required the EE-25 can be fitted with a supply-loading hydraulic crane with a maximum capacity of 5000 kg (11,023 lb) and a front-mounted winch with a capacity of 3000 kg (6614 lb) and provided with 50 m (164 ft) of cable. Optional equipment includes fire extinguishers, more powerful winches, a power take-off (PTO) and, for use in cold areas, an engine starting aid. A 4×4 model of the EE-25 is available with a similar payload to the 6×6 model. Variants of the EE-25 produced so far include a lubrication vehicle, recovery vehicle, tanker (fuel or water), firefighting truck, prime mover, and fully-enclosed command post or ambulance.

Specification

EE-25
Crew: 1+2
Weights: empty 6800 kg (14,991 lb); loaded (cross-country) 9300 kg (20,503 lb)
Powerplant: one Mercedes-Benz type OM-352A 6-cylinder diesel developing 129.8 kW (174 hp)
Dimensions: length 6.82 m (22 ft 4.5 in); width 2.25 m (7 ft 4.6 in); height (cab) 2.50 m (8 ft 2.4 in)
Performance: maximum road speed 90 km/h (56 mph); maximum range 600 km (373 miles); gradient 60 per cent; side slope 30 per cent; fording 0.9 m (2 ft 11.4 in)

The Brazilian ENGESA company first became involved in trucks by the conversion of 4×2 and 6×4 trucks into all-wheel drive for improved cross-country mobility. ENGESA now produces an extensive range of not only 4×4 and 6×6 trucks but also armoured vehicles.

This model of the Brazilian ENGESA EE-25 2500-kg (5,511-lb) 6×6 truck is fitted with single rear tyres. All ENGESA 6×6 vehicles feature the famous Boomerang rear suspension, which ensures that all four of the rear wheels are in constant ground contact, for maximum traction.

FRANCE

ACMAT VLRA 2500-kg 4×4 truck

For many years the trend has been to adapt a standard commercial vehicle to meet military requirements by the adoption, for example, of all-wheel drive, stronger suspension, bigger wheels, stronger cabs and a special body. The French company ACMAT (Ateliers de Construction Mécanique de l'Atlantique) based at Saint-Nazaire believes that in order to be entirely reliable any military truck must be built to meet the most demanding of military requirements yet must be as simple as possible. The result is the ACMAT range of cross-country vehicles which are now in use with more than 30 countries all over the world.

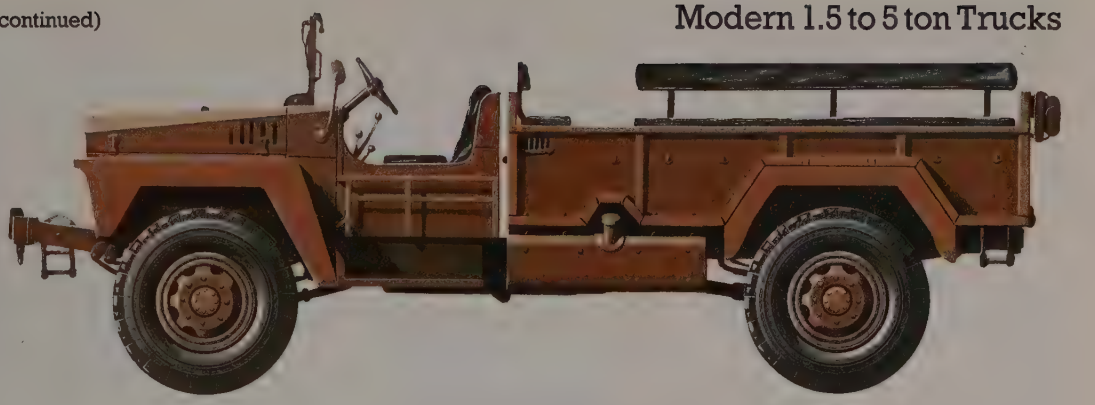
The basic cargo truck is the **TPK 4.15 SM2**, which can carry 1500 kg (3,307 lb), while the longer-wheelbase **TPK 4.20 SM2** can carry 2500 kg (5,512 lb) of cargo and tow a trailer or artillery piece weighing weight up to 3000 kg (6,614 lb). There is also a long-wheelbase model with slightly greater carrying capacity, and a 6×6 model which can carry a maximum payload of 4300 kg (9,480 lb). The latter model has a slightly more powerful engine, but every version uses the same front axles, wheels, tyres and reduction boxes so that the operator need not keep an extensive range of spare parts for his vehicle fleet. This not only reduces costs but eases training.

One of the many roles of the ACMAT VLRA TPK 6.40 SM2 6×6 truck is that of laying a portable roadway over soft terrain so that following trucks can cross without becoming bogged down. The cargo model of this truck can carry a maximum payload of 4300 kg (9,480 lb).

The layout of the ACMAT is conventional, with the engine at the front, the cab in the centre and the cargo area at the rear. The latter has a dropdown tailgate, removable bows and a tarpaulin cover. When the vehicle is used in the troop-carrying role seats can quickly be fitted down the centre or sides of the cargo area. All vehicles have long-range fuel tanks, a 200-litre (44-Imp gal) water tank, sand channels which are considered essential for operations in the desert, and four jerrycans. Optional equipment includes a front-mounted winch with a capacity of 3000 kg (6,614 lb) a rear towing pintle, power steering, and a wide range of weapons such as a Milan anti-tank missile, a 60-mm (2.36-in) or 81-mm (3.19-in) mortar, a 7.62-mm (0.3-in) or 12.7-mm (0.5-in) machine-gun, or even a twin 20-mm (10.78-in) anti-aircraft cannon system.

There are so many versions of the ACMAT truck that it is possible to mention only a few of them. The com-

mand and control vehicle is the **TPK 4.20 VCT**, and this is fitted with extensive communications equipment. The TPK 4.20 chassis can be used as a light recovery vehicle, or as a firefighting vehicle or as a bowser (fuel or water). It can also be fitted with many box bodies/shelters for use in specialized roles. The chassis is also used as the basis for an armoured car/armoured personnel carrier. The 6×6 TPK 6.40 SM2 can also be used for many other roles including recovery, portable roadway laying, tar spreading, tipping, and as a bowser.



The French ACMAT VLRA range of 1500-kg (3,307-lb) cross-country trucks are used by more than 30 countries around the world and have established a reputation for reliability and durability. Their 240-litre (53-gal) fuel tanks give a range of 900 km (560 miles).

Specification
TPK 4.20 SM2
Crew: 1+2
Weights: empty 4300 kg (9,480 lb); loaded (cross-country) 6800 kg (14,991 lb)
Powerplant: one Perkins Model 6.354.4 diesel developing 89.5 kW (120 hp)
Dimensions: length 6.00 m (19 ft 8.2 in); width 2.07 m (6 ft 9.5 in); height (cab) 1.83 m (6 ft 0 in)
Performance: maximum road speed 100 km/h (62 mph); maximum range 1600 km (994 miles); gradient 60 per cent; side slope 30 per cent; fording 0.9 m (2 ft 11.4 in)

NETHERLANDS

DAF YA 4440 4000-kg 4×4 truck

In the 1950s DAF designed a complete family of cross-country vehicles to meet the requirements of the Dutch army. These included the **YA** 4×4 weapons carrier, the **YA 314** 4×4 and **YA 328** 6×6 3000-kg (6,614-lb) trucks, and the heavy **YA 616** 6×6 6000-kg (13,228-lb) truck. The trucks are now being replaced by two new DAF designs which are based on vehicles already in production for civil applications. These are the **DAF YA 4440** 4×4 4000-kg (8,818-lb) and **YAZ 2300** 6×6 10000-kg (22,046-lb) trucks, both of them featuring more fuel efficient diesel engines and ZF hydraulic steering.

The Dutch army placed its first order for 4,000 YA 4440 trucks in 1976, and all of these were delivered between 1977 and 1980; since then a further 2,500 vehicles have been supplied. The all-steel forward control cab has a reinforced roof so that a 7.62-mm (0.3-in) machine-gun can be installed for anti-aircraft defence, and this cab can be tilted forward to allow access to the engine and transmission for maintenance. The rear cargo area has side boards and a tailgate that can be quickly removed to allow containers and other bulk cargo to be loaded; bows and a tarpaulin cover are also provided. The engine is coupled to a manual transmission with five forward and one reverse gear and a transfer case. Suspension, front and rear, consists of semi-elliptical springs and double-acting hydraulic shock absorbers.

The normal version has a single passenger seat, but if required the vehicle can be delivered with a two-man passenger seat. Other optional equipment includes a 1000-kg (2,205-lb) manually-operated crane and an automatic transmission. The Dutch army has also taken delivery of 375 examples of a version fitted with a larger four-man cab for driver training purposes. In forward areas it is often difficult to find cranes and other mechanical handling equipment to unload trucks, so the Dutch army has also taken delivery of 200 vehicles fitted with a HIAB hydraulic crane to the cab rear. This can be used to either side of the vehicle, though stabilizers have to be lowered to the ground before the crane is used. The Dutch army and navy also use the

A DAF YA 4440 4000 kg (8,818 lb) cargo truck with bows and tarpaulin cover in position at the rear. Like most military trucks today, the YA 4440 is essentially a standard civilian truck with a few modifications to suit it for military use.

DAF YA 5441/5442 4×4 5000-kg (11,023-lb) cargo truck, which uses many components of the DAF YA 4440. This model does not have the cross-country mobility of the earlier vehicle.

Specification
YA 4440
Crew: 1+1
Weights: empty 6900 kg (15,212 lb); loaded (cross-country) 10900 kg (24,030 lb)
Powerplant: DAF DT 615 6-cylinder turbocharged diesel developing 114.1 kW (153 hp)
Dimensions: length 7.19 m (23 ft 7.1 in); width 2.44 m (8 ft 0 in); height (tarpaulin cover) 3.42 m (11 ft 2.6 in)
Performance: maximum road speed 80 km/h (50 mph); maximum range 500 km (311 miles); gradient 50 per cent; side slope 30 per cent; fording 0.9 m (2 ft 11.4 in)

Today the Dutch army is replacing its 1950s generation vehicles with a whole new series built by DAF. Over 6,500 of these DAF YA 4440 4000-kg (8,818-lb) trucks are now being delivered. The model on the left is fitted with an HIAB crane for handling pallets.

Desert Ambush

As it jolted along the rocky Omani track, the British convoy could be seen for miles. Armed to the teeth, the rebel tribesmen watched from the hills as the column drew closer and closer.

Although air power played a major part in the Radfan operations, much of the men and supplies were brought up by truck. Here infantry set up recoilless rifles and 7.62-mm Machine-Guns while a Bedford RL 4×4 truck unloads supplies in the background.

Most people who spent time in the post-war British army developed a love/hate relationship with the ubiquitous 3-tonner. It could be an incredibly welcome sight as it arrived bringing spares and supplies; it could be an equally hateful sight as it arrived to carry one off to a particularly unpleasant position. It would be praised when it successfully navigated a stretch of stony desert; it would be cursed when it bogged down on a jungle track miles from anywhere. Probably no truck in the world could have successfully stood up to all the demands made on the poor old 3-tonner by unit commanders and drivers alike. The 3-tonner simply was as much a fact of military life as incomprehensible orders or a good posting. If the breaks came your way you enjoyed them, and if they did not you simply put up with them. There was nothing intrinsically exciting about the 3-tonner, in the same way that there is about a tank, a new weapons system or even the latest radio set. This is slightly unfair, because men and materials have to be transported in order for battles to be won or (hopefully) prevented: it might not be glamorous, but the 3-tonner and the men who drove it were, and still are, as important to the British army as any other piece of kit.

Cross-country driving

There is one question that anyone who has spent time in the British army will remember either being asked or asking: 'Do you think we can get a 3-tonner down there?' 'Down there' was anything from a bog on Dartmoor, to a wadi strewn with the largest and sharpest boulders in the Middle East, or a track running through a particularly dense patch of secondary jungle. The 3-tonner (and its driver) was expected to be able to go anywhere and do anything, much to the subsequent fury of command workshops personnel when yet another 3-tonner was towed in for a complete overhaul, or simply reported as having been abandoned when it started to sink into mud or sand up to and over its mudguards. Possibly the standing order that the driver of a disabled vehicle should stay with it was designed to make drivers think before they asked the impossible of their vehicle: no one likes spending the night by himself in the middle of the jungle with only the mosquitoes and an occasional tiger for company. That standing order is only operative in peacetime, incidentally; in battle conditions not even Whitehall expects someone to stay near a burnt-out hulk, or even stay inside a 3-tonner while bullets and mortar shells are zeroing in on it. Although slightly armoured and often carrying a mounting for a machine-gun, the 3-tonner was not actually a fighting vehicle, but in the past 30 or so years it has probably been on the receiving end of more enemy bullets and shells than any tank. So it is worth taking a look at the 3-tonner 'in action'. As usual, the poor old thing is on the receiving end. It is a shame, in a way, that it was never fitted out as a rocket launcher in the Soviet fashion (and as also used to great effect by the Viet Cong against the French, the South Vietnamese army and the Americans), for it would have been nice for the British 3-tonner to have had its own moment of glory. (The exceptions are the 'portées' used in the Western Desert in World War II by the SAS, LRDG etc.: these trucks were fitted with anti-tank guns, firing over the cab.)

The federation of semi-autonomous states now known as the United Arab Emirates used to be known as the Trucial Oman States. Until 1973 they owed their allegiance to the Sultan of Oman, though under the protection of the British government through a series of treaties going back to the last century. Sharjah was an extremely important RAF staging post, and the neighbouring emirate, Dubai, acted as an entrepot port for the entire region. Supplies for the British forces (mostly the Special Air Service) helping the Omanis fight their own rebels (some tribal, some Soviet-inspired) often passed through these two towns, now sizeable modern cities. Both Dubai and Sharjah also provided sea and air cargo facilities for the Trucial Oman Scouts (British officers and senior NCOs) who did such an excellent job in preserving the stability of the region until independence.

The mountain tribes

Thus it is interesting to look at a military convoy from Dubai en route to a destination in Oman. This is not the famous convoy that, in 1963, carried two pedigree bulls to upgrade the Omani herds, but one carrying men and equipment, and well aware that it could be ambushed en route by a party of desert Bedu, out for a little harmless fun (they call it a *razziah*, from which comes the English expression 'going on the razzle'); or by tribesmen loyal to the 'mad' Mahdi, secure in his fastness on the Green Mountain; or by anybody who had an interest in destabilizing the region. The convoy consists of four 3-tonners and three accompanying Land Rovers, equipped for desert combat. The driver in the lead 3-tonner is the most experienced and is best able to decide if his truck can safely go over difficult terrain. Like all the other drivers he has an open windscreen, which is against orders, but a fraction cooler. To keep the dust out of his eyes he is wearing army-issue sand goggles; and around his head he is wearing the standard arab headress, or *keffiah*, which is still the most practical and comfortable garb to wear in the desert. His vehicle has, so far as possible, been 'customized' for the Middle East: the engine well cleaned (oil and grease attract sand), essential protection taken against dust (heavy-duty air filters etc.), and with long-range petrol tanks, and jerrycan upon jerrycan of water provided.

Night bivouac

For the first 48 km (30 miles) or so the route runs through stony desert, which presents no real problem: the tyres are thick enough to withstand most of the sharp flints or rocks, and the track is reasonably smooth. Any sand dunes are given a wide berth. Soon, however, the stony desert gives way to a flat plain of whitish sand, and here the drivers must be extremely careful: the ground may appear solid enough, but in fact they are driving over a salt marsh. If they stay on the track well and good, but the slightest deviation can mean the truck will break through the surface crust and become hopelessly mired. This is an area that even camels sometimes have difficulties in traversing. The convoy is making for a range of sharply rugged mountains that looms out of the heat haze in the distance. Mostly impregnable, the mountains can be crossed by following dried-up river beds (wadis), and it is one such wadi that is reached shortly before dusk. The convoy bivouacs for the night. Guards are posted, but neither drivers nor troops are encouraged to sleep in their vehicles: they might provide a modicum of protection against scorpions and spiders, but they can also be deathtraps if a well-placed mortar bomb explodes on or even close by one.

The moment the Land Rover hit the mine, the troops leap from their trucks and take cover among the rocks. Soon the crack of the tribesmen's rifles is punctuated by the ominous thump of a mortar, the bombs exploding on the side of the wadi showering the British with a lethal mixture of rock and steel splinters.

Unarmoured and full of petrol, the trucks are abandoned as potential deathtraps by their crews. The Bedfords have been modified for desert driving, the engines fitted with heavy duty filters and a liberal supply of water and spares carried in the back. Contrary to orders the drivers have left their windscreens open.

Desert Ambush

Come first light and the convoy starts its slow, tortuous way along the wadi. Here the large tyres prove a mixed blessing: on the one hand they do enable the truck to clear large boulders, but on the other they play havoc with the 3-tonner's centre of gravity, so that a sudden lean to the left or right can result in the truck toppling over, or veering out of control into a large boulder that could just fracture its radiator. Gradually the walls of the wadi get steeper and steeper. The lead driver is possibly wondering how much longer it will be before they find the valley that will finally take them through the mountains, if only because this is an ideal place for an ambush. And just as he thinks that his Land Rover hits a mine and disintegrates in a shower of broken metal and bodies.

Short of sending a party of engineers in front with mine-detection equipment, there was no way of spotting such a mine: small rocks and boulders prove the ideal camouflage. The only problem now is whether the mine had been laid as a singleton or as part of a small field. And is it part of an ambush? A burst of small arms fire that rips into the convoy as a whole settles the latter question, and the Immediate Action ambush drill takes over. Obviously the convoy cannot go forward, as the way is blocked by the flaming wreckage of the lead Land Rover. No more can the convoy retreat: there is no place to turn round, and reversing out of an ambush at a top speed of around 3.2 km/h (2 mph) is an action not calculated to save lives. (Wadi driving is notoriously slow.)

Everyone gets out of the 3-tonners at top speed. The small arms fire is coming from the convoy's left, high up on the mountain side, so the officers and NCOs get their men as fast as they can to the left bank where they can get some protection. One or two soldiers may try and stay on the right side of the wadi, keeping their vehicles between them and the enemy, which is as good an invitation to being killed in action as you could find: when those long-range petrol tanks explode, as they are quite likely to, they will incinerate anyone within at least 18.3 m (20 yards). The navy may be prepared to go down with its ships, but the army has always been less sentimental about its trucks. So the idea is to get out and get as far away as is practical without bunching in the process, because one well-aimed mortar round (or one lucky mortar round) is all it takes to wipe out a closely bunched platoon. Almost upon cue a sharp crack, followed by an explosion and a shower of rock fragments, signals that there is indeed a mortar. It is zeroed on the convoy, and no ranging shots are necessary for the column of vehicles has driven directly into the killing ground, and the chances are that very few of them will be able to drive back. Ambush Immediate Action drill in the jungle calls for the ambushed party to charge the ambushers. It is not as heroic or foolhardy as it sounds: you will probably get killed if you stay where you are anyway, and a reasonably well disciplined charge stands every chance of getting you to close quarter grips with the enemy, where your superior (in theory) training and fitness should give you the advantage. The same does not hold true for this situation, of course, since it is a little difficult to charge up a mountain side. The rebels, whoever they are, have picked their ambush site extremely well. Obviously the convoy or what is left of it (a well planned ambush should kill or incapacitate at least 50 per cent of the trapped party within the first five minutes) cannot stay where it is. Even though fire is now being returned by rifle and Bren gun and a few sharpshooters have somehow managed to find themselves natural 'sangars' from which to fire well-aimed shots at their attackers, the situation is basically intolerable. The opposing mortar is firing from a point up ahead, from the other side of a sharp bend in the course of the wadi, and there is, thankfully, very little fire coming from the rear. The convoy commander estimates that there are at most two or three riflemen posted there to prevent an escape. This is in itself slightly puzzling, because a good ambush commander will site some of his strongest firepower at the rear of the ambush simply to prevent an escape. It could be that there is a larger force there, waiting silently to cut them to ribbons if they try to retreat the way they came; this is highly unlikely, however, because though the rebels in this part of the world may be extremely brave they are not disciplined and, once the firing starts, they all open up with everything they have got. The final clue comes from the behaviour of the mortar firing against them. It is being laid (and well laid) to explode its bombs on the mountainside above the sheltering soldiers, so that they are being bombarded with rock fragments every bit as lethal as any bullet ricochet. Those trucks, that should be such superb sitting targets, are being studiously left alone. Obviously the attacking force wants the trucks and especially their contents. The commander really has only one decision to make. Although a radio was salvaged and he has managed to signal the British position, help will not arrive for at least three hours. And as soon as the attackers realize that help is on its way, they will destroy the 3-tonners anyway, on the basis that if they cannot have them, no one can. Under covering fire, the commander orders the retreat, and is not surprised to see the enemy fire slacken as his men slither and crawl their way to safety. With the bulk of his men safely (he hopes) out of the killing ground, only one thing remains to be done: a few well thrown grenades plus a quick burst from the Bren gun, and the 3-tonners explode, their smoke and flames providing a very useful cover for the escape. It is not quite the same thing as shooting your own horse to deny it to the enemy, but even so the commander and his men feel a slight twinge of regret as the four trucks they had so carefully shepherded this far burn down to their wheel rims. The trucks and their contents were on the commander's signature, and while no one is going to make him pay for them, they are going to ask him an awful lot of questions. Anyway, there is plenty of time to think of that on the long trek back. With any luck, HQ will send a couple of 3-tonners out to pick them up, so they will not have to walk too far. In a way the 3-tonners got the commander and his men into this mess, so it is only fitting that 3-tonners should get them out again.

Left: A Bedford RL 4×4 truck creates a dust cloud to its rear as it moves along a track in the Radfan. The Royal Engineers had to clear a path across the rocky terrain before the trucks could get through, and even then progress was often slow due to many punctures.

Above: Conditions in the Radfan operation were so tough on vehicles that their useful life was measured in months rather than years. Many vehicles were fitted with special protection against mines.

ITALY

FIAT 90 PM 16 4000-kg 4×4 truck

For many years FIAT has supplied the majority of wheeled tactical vehicles required by the Italian army. The latest military trucks from this source are the **FIAT 75 PM** 2500-kg (5,512-lb) 4×4 and the **FIAT 90 PM** 4000-kg (8,818-lb) 4×4 vehicles. Production of both is undertaken at the FIAT plant at Bolzano in northern Italy. The first figure in the designation is the approximate gross vehicle weight, while the P stands for *Pesante* (heavy-duty service) and the M for *Militare* (military). So far the Italian army has ordered almost 4,000 vehicles and Somalia some 120.

In addition to carrying 2500 kg (5,512 lb) of cargo, the FIAT 75 PM can also tow a trailer or weapon weighing up to 4000 kg (8,818 lb). As far as it is known, the Fiat 90 PM 16 truck has yet to enter service with the Italian army, although a small quantity of the basic cargo version has been supplied to Somalia, while Venezuela has taken delivery of 60 models fitted with a 5000-kg (11,023-lb) crane by FARID of Ifaly.

The fully enclosed cab is of the forward control type, and can be tilted forward to allow access to the engine for maintenance purposes. In the cab roof on the right side is a circular observation hatch, and on this a 7.62-mm (0.3-in) machine-gun can be fitted for anti-aircraft or local defence. The all-steel rear cargo area has drop sides and a tailgate which can be removed if required, bows and a tarpaulin cover. When used in the troop transport role, the vehicle can be fitted quickly with seats. The engine is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. Most vehicles of this type normally have their front axle disengaged when being driven on roads to make them 4×2 rather than 4×4 vehicles. The suspension, front and rear, consists of leaf springs with hydraulic telescopic shock absorbers. The brakes are of the dual-circuit air type, the parking brake being mechanical. Optional equipment includes an air-operated lockable front differential and a front- or rear-mounted winch with a capacity of 4000 kg (8,818 lb).

Some years ago the company built a halftrack model of the FIAT 90 PM 16 called the **HT 90**. This had its rear wheels replaced by a complete halftrack system similar to that fitted to American halftracks of World War II, but did not progress past the prototype stage. The British company Laird has built prototypes of a similar halftrack multi-role vehicle called the Centaur. This is a long-wheelbase Land Rover chassis fitted with a halftrack system on each side in place of the rear axles. The Centaur has been tested by the British army and evaluated by a number of countries in the Middle East, but has yet to enter volume production.

The FIAT 90 PM 16 4000-kg (8,818-lb) truck is a member of a complete range of trucks developed at the Lancia plant in Bolzano, northern Italy, for civil and military roles. The smaller FIAT 75 PM, with a payload of 2500 kg (5,511 lb), is already in service with the Italian army.

Specification

FIAT 90 PM 16
Crew: 1+1
Weights: empty 5750 kg (12,677 lb); loaded (cross-country) 9750 kg (21,495 lb)
Powerplant: one FIAT Model 8062-24 6-cylinder supercharged diesel developing 119.3 kW (160 hp)
Dimensions: length 6.352 m (20 ft 10.1 in); width 2.30 m (7 ft 6.6 in); height 2.935 m (9 ft 7.6 in)
Performance: maximum road speed 80 km/h (50 mph); maximum range 700 km (435 miles); gradient 60 per cent; side slope 30 per cent; fording 0.85 m (2 ft 9.5 in)

FINLAND

SISU A-45 3000-kg 4×4 truck

When the Finnish army drew up its requirement for a 4×4 vehicle capable of carrying 3050 kg (6,724 lb) of cargo across country or 4050 kg (8,929 lb) of cargo on roads, it was natural that SISU-Auto AB of Helsinki would be approached as the company is totally familiar with the demanding requirements of Finland's climate and terrain. The result was the **SISU A-45** truck, which meets all of the Finnish army's requirements and has also been adopted for a number of civil applications. The forward control cab is unusual in that its lower part is made of steel while the detachable upper part is fabricated of glassfibre, enabling the vehicle to be prepared quickly for air transport. This is of some importance as Finland has on many occasions sent contingents of troops overseas to operate as part of United Nations' peacekeeping forces. The engine is under the cab and projects a short distance into the rear cargo area, and is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. Steering is power-assisted on the front wheels, and tyres are 14.00×R20 all round. The suspension front and rear consists of semi-elliptical leaf springs with shock absorbers for the front axles only.

The rear cargo body is of all-steel construction and attached to the chassis by special rubber mountings for greater flexibility. The sideboards and tail gate can be folded down to assist in the loading of cargo, and the tailgate is provided with inbuilt access steps.

Optional equipment for the SISU A-45 truck includes a hydraulic winch with a capacity of 6500 kg (14,330 lb) and 60 m (197 ft) of cable which can be used to the front or rear of the vehicle for self-recovery or to recover other vehicles that have become bogged down. A blowlamp-operated coolant and oil-sump heater is provided for use in very cold conditions such as those encountered in Finland, while the basic vehicle is fitted with a cab heater. One of the more unusual options for this truck is a hydraulic take-off for any towed trailer or artillery weapon: for example, if a two-wheel trailer is being towed the whole truck/trailer combination has a 6×6 configuration and greater cross-country mobility. The basic A-45 truck can tow a maximum load of 2000 kg (4,409 lb) across country, or 4000 kg (8,818 lb) on roads.

The latest SISU truck to enter service with the Finnish army is the **SA-150 VK** 4×4 vehicle, which can carry a maximum payload of 6400 kg (14,110 lb) and is fitted with a 8000-kg (17,637-lb) capacity winch. Components of this truck are also used in the new Finnish SISU XA-180 6×6 amphibious armoured personnel carrier, which has recently entered service with the Finnish army.

Specification

A-45
Crew: 1+2
Weights: empty 5950 kg (13,118 lb); loaded (cross-country) 9000 kg (19,842 lb)
Powerplant: one 6-cylinder diesel developing 96.9 kW (130 hp) or turbocharged diesel developing 119.3 kW (160 hp)
Dimensions: length 6.00 m (19 ft 8.2 in); width 2.30 m (7 ft 6.6 in); height (cab) 2.60 m (8 ft 6.4 in)
Performance: maximum road speed 100 km/h (62 mph); maximum range 700 km (435 miles); gradient 60 per cent; side slope 30 per cent; fording 1.0 m (3 ft 3.4 in)

This SISU A-45 4×4 cargo truck has sideboards and a tailgate that can be lowered to enable the rapid loading and unloading of cargo by fork lift trucks. To facilitate air transport the upper part of the fully enclosed three-man cab can be quickly removed.

SWEDEN

Saab-Scania SBA 111 4500-kg 4×4 truck

Many countries today base their military vehicles on a standard civil chassis to which are grafted all-wheel drive, larger wheels and tyres, a more powerful engine and military-type cargo area. The terrain over which the Swedish army would be required to operate in time of war is so severe, however, that a decision was taken to design a new family of cross-country vehicles in the early 1960s. In the end Volvo designed the lighter 4×4 and 6×6 vehicles, while Saab-Scania designed the heavier vehicles. First prototypes were completed in 1971 and after the usual trials and modifications, effected at the request of the operator, production got under way at Saab-Scania's Söndertälje facility in 1976. About 2,500 vehicles were produced for the Swedish army, navy and air force by the time production was completed in early 1982. Finland took delivery of 33 SBAs, and a quantity was also built for civil use.

The family comprises two vehicles, the **Saab-Scania SBA 111** 4×4 truck and the **SBAT 111S** 6×6 truck, with both vehicles sharing many common components. The SBA 111 can carry 4500 kg (9,921 lb) of cargo across country and 6000 kg (13,228 lb) on roads, while the SBAT 111S can carry 6000 kg (13,228 lb) of cargo across country and 9000 kg (19,842 lb) on roads. The main difference between the two vehicles is that the 6×6 model is powered by a supercharged version of the D11 that develops 296 hp (220.7 kW).

The all-steel two-door forward control cab is much stronger than that fitted to many military vehicles, and will protect the crew even if the vehicle turns over. This cab can be tilted forward at an angle of 55° for access to the engine. The latter is coupled to an automatic gearbox and a two-speed transfer case. Suspension consists of semi-elliptical springs and double-acting hydraulic shock absorbers, and the steering is of the hydraulic type essential for operations over terrain such as that encountered in Sweden.

The rear cargo area has drop sides and a drop tailgate (quickly removable to enable bulk cargo to be carried) as well as removable bows and a tarpaulin cover. Both the 4×4 and 6×6 vehicles have a hydraulic winch with a capacity of 8000 kg (17,637 lb) which can be used to the front or rear of the vehicle, and many have a 1500-kg (3,307-lb) hydraulic crane for unloading purposes.

The Swedish army uses the SBAT 111S to tow the Bofors 155-mm (6.1-in) FH-77A howitzer, and this model is fitted with a fully enclosed compartment to the rear of the cab to carry the gun crew, while another 6×6 vehicle carries additional ammunition. Other versions of the 6×6 model include a crash rescue vehicle for use at airfields, another to carry the Giraffe radar system for use with the RBS-70 surface-to-air missile system, and a 4×4 model used for clearing snow at Swedish airfields.

Specification

SBA 111

Crew: 1+1

Weights: empty 9150 kg (20,172 lb); loaded (cross-country) 13700 kg (30,203 lb)

Powerplant: one D11 6-cylinder diesel developing 164.1 kW (220 hp)

Dimensions: length 6.75 m (22 ft 1.75 in); width 2.49 m (8 ft 2 in); height (cab) 2.90 m (9 ft 6.2 in)

Performance: maximum road speed 90 km/h (56 mph); maximum range 600 km (373 miles); gradient 60 per cent; side slope 40 per cent; fording 0.8 m (2 ft 8.5 in)

To meet the requirements of the Swedish air force, Saab-Scania have built a special snow-clearing model of the SBA 111 4500-kg (9,921-lb) truck. This is fitted with a ROLBA 1500S snow-clearing system and is driven backwards when clearing snow.

Between 1976 and 1982 Saab-Scania delivered 2,500 of the SBA 111 4500-kg (9,921-lb) and SBAT 111S 6000-kg (13,227-lb) trucks to the Swedish armed forces. These share many common components, the major difference being that the D11 engine of the SBAT 111S is supercharged.

USA

M813 5-ton 6×6 truck

The most widely used trucks in the modern US Army are the 2.5- and 5-ton 6×6 series. The first range of 5-ton trucks to be completed after the end of World War II was the **M54** series, which was built by a number of manufacturers including Diamond T, Kaiser Jeep (later AM General), Mack and International Harvester. Further development of the M54 series resulted in the **M809** family which entered production at AM General in 1970 for a total amounting to well over 40,000 vehicles (home and export markets) by 1985.

The basic chassis is the M809, while the standard cargo truck is the **M813**, which can carry 4536 kg (10,000 lb) across country or 9072 kg (20,000 lb) on roads, the towed loads being 6817 kg (15,030 lb) and 13608 kg (30,000 lb) respectively. The layout of the vehicle is similar to that of the M35, the major distinguishing features (apart from the difference in size) being the air cleaner on the left mudguard and the high exhaust pipe on the right side of the cab forward of the door. The engine is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. The steering is power-assisted on the front wheels. The rear cargo area has drop tailgate, removable bows and tarpaulin cover, and foldable seats down each side are provided so that troops can be carried.

Optional equipment includes a deep fording kit which enables the vehicle to wade to a depth of 1.98 m (6 ft 6 in) which is essential when the truck is being used by the US Marines during amphibious operations, a front-mounted winch, an A-frame, special equipment for operations in cold weather, an anti-aircraft machine-gun on ring mount above the cab, a fully-enclosed cab, hard-top in place of the normal soft-top, a slave starting device, and so on. The vehicle is used primari-

The M813 5-ton 6×6 cargo truck is a further development of the M54 series developed in the 1950s. Until the introduction of the new M939 series of 5-ton trucks, the M813 was the standard vehicle in its class in both the US Army and Marine Corps.

ly for the carriage of cargo, but is also used to tow the 155-mm (6.1-in) M198 and M114 howitzers and to tow various missiles.

Variants of the M809 family include the **M813A1** which has drop sides and tailgate to facilitate the bulk loading of cargo with forklift trucks, the **M814** long-wheelbase cargo truck which is often used to carry containers with surveillance radars, the **M815** bolster truck, the **M816** recovery vehicle (or wrecker as the Americans prefer to call it), the **M817** dump truck which can be fitted with bows and a tarpaulin cover to carry cargo, the **M818** tractor, the **M819** tractor/wrecker, the **M820** shop van, and the **M821** bridge transport; the type can also carry and launch components of the Ribbon Bridge.

Further development of the M809 family has resulted in the **M939** which is now in production for the US Army and US Marines.

Specification
M813
Crew: 1+2
Weights: empty 9750 kg (21,496 lb); loaded (cross-country) 14294 kg (31,512 lb)
Powerplant: one NHC-250 6-cylinder diesel developing 179.0 kW (240 hp)
Dimensions: length 7.645 m (25 ft 1 in); width 2.464 m (8 ft 1 in); height (overall) 2.946 m (9 ft 8 in)
Performance: maximum road speed 85 km/h (53 mph); maximum range 563 km (350 miles); gradient 67 per cent; side slope 42 per cent; fording 0.76 m (2 ft 6 in)

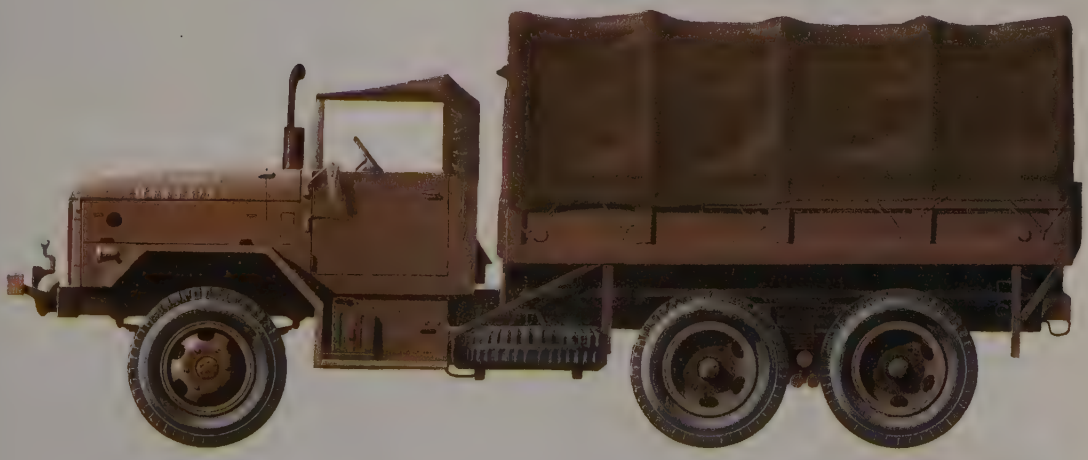
This American AM General M809 5-ton 6×6 cargo truck is fitted with an Enhanced Mobility System that allows the truck driver to adjust the tyre pressure to suit the type of ground being crossed.

USA

M35 2.5-ton 6×6 truck

The M35A2 is the most common model of this extensive range of 2.5-ton 6×6 trucks used by the US Army and countless other armies in every corner of the world. Current models have a much more fuel-efficient engine than the original petrol-engined vehicles of the 1950s.

During World War II the 2.5-ton 6×6 truck was the workhorse of the Allies, but after the end of the war plans were drawn up for its replacement. General Motors built the **M135** 2.5-ton truck with single wheels and the **M211** with dual rear wheels, while Reo built the **M34** with single rear wheels and the **M35** with dual rear wheels. It was intended that the Reo vehicle would be the standard vehicle in its class in the US Army, and the M34/M35 series was standardized and commonly known as the **Eager Beaver**. First producion vehicles were powered by a petrol engine, but the **M35A1** had a multi-fuel engine and the **M35A2** a multi-fuel diesel. In the late 1960s the M35 family, as well as other trucks, were manufactured by the Defense and Government Products Division of Kaiser Jeep, but in 1970 this company was taken over by American Motors and today is known as the AM General Corporation. The M35 series is the most widely used range of military trucks in the West, the US Army alone having over 65,000 vehicles of this type. The current production model is the M35A2 as the M34 with single rear wheels is no longer produced, although it does remain in service with a number of countries.



The layout of the M35 is identical with that of the 2.5-ton truck produced in World War II: the engine is at the front, the cab in the centre with a removable top and forward-folding windscreen, and the cargo area at the rear. The last has a stake-type body with a drop tailgate, removable bows and a tarpaulin cover. Along each side of the cargo body are folding troop seats. The engine is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case.

As the truck has to be used in a variety of climates and to carry out different missions, a complete range of optional equipment is available. Typical are a winch with a capacity of 4536 kg (10,000 lb) which can be used to the front or rear of the vehicle, an A-frame mounted at the front for field repairs, a fully-enclosed cab, a kit to enable vehicle to ford to a depth of 1.98 m (6 ft 6 in), slave cables for emergency starting, centre troop seats, special heaters for the engine and cargo area, and so on. The basic cargo vehicle can carry 2268 kg (5,000 lb) of cargo across country or 4536 kg (10,000 lb) on roads.

There are many variants of the M35, including the **M36** long-wheelbase cargo truck, the **M48** tractor truck, the **M49** fuel tanker, the **M50** water tanker, the **M59** dumper, the **M60** and **M108** wrecker, the **M109** shop van, the **M185** repair van, the **M292** shop van with extending sides and the **M342** dump truck. The **M963** is a product-improved M35A2, but has not so far entered production. It is likely that the M35 family will be replaced by a new 4×4 forward-control vehicle which is currently designated the Medium Tactical Truck (MTT).

Specification
M35
Crew: 1+2
Weights: empty 5900 kg (13,007 lb); loaded (cross-country) 8168 kg (18,007 lb)
Powerplant: one LDT-465-1C 6-cylinder multi-fuel diesel developing 104.4 kW (140 hp)
Dimensions: length 6.71 m (22 ft 0 in); width 2.39 m (7 ft 10 in); height (overall) 2.90 m (9 ft 6 in)
Performance: maximum road speed 90 km/h (56 mph); maximum range 483 km (300 miles); gradient 60 per cent; side slope 30 per cent; fording 0.76 m (2 ft 6 in)

An M35 series 2.5-ton 6×6 truck is off-loaded from a ship. The US Army has some 65,000 of these trucks, whose design can be traced back around 35 years. It will be replaced by a new vehicle called the Medium Tactical Truck, which will probably be a 4×4.

M35 2.5-ton 6x6 truck

The basic cargo version of the M35A2 2.5-ton 6×6 truck is conventional in its layout, with removable canvas top and a windscreen which can be folded forward on to the bonnet. The cargo area has a drop tailgate and troop seats down each side; the M35A2c has drop sides as well. The chassis has been used for a wide number of specialist vehicles, including fuel tankers, water carriers, dump trucks, medical vans and recovery vehicles.

US Army 5-ton trucks

As mentioned separately, the M809 family of 5-ton 6×6 trucks was a further development of the M54 series that entered service with the US Army in the 1950s. Even when the M809 family entered service in 1970 it was known that further improvements were required in the key areas of transmission, transfer case and brakes, but with the ending of war in South East Asia the whole programme was shelved. In the mid-1970s this got under way again and the improved vehicle was eventully standardized as the M939 series. After the US Army had received competitive bids from a number of leading American truck manufacturers, AM General was awarded the production contract in 1981. The contract was valued at $628 million and covered the supply of 11,394 of the vehicles with a 100 per cent option. This is a large number of trucks, but the figure must be regarded in the context of a US Army overall requirement for almost 60,000 5-ton trucks and that in 1981 the US Army had just under 34,000 such vehicles on strength, of which almost 2,000 were over 15 years old. The first production M939 series vehicles were completed at AM General's plant at South Bend, Indiana, in 1982. The older M809 series is still in production for the export market as the M939 has yet to be released for foreign buyers.

The M939 family has a number of improvements over the earlier vehicles, including a fully automatic transmission in place of the standard manual box, a new two-speed transfer case, air brakes all round with a longer life than the earlier air/hydraulic brakes, the exhaust pipe relocated to the rear of the cab to meet the stringent requirements laid down by the Surgeon General to reduce noise levels for the crew, replacement of the mechanically-operated front-mounted winch by a hydraulic unit, and a three-man instead of two-man cab. To enable the crew to work on the engine more easily the bonnet and front bumper tilt forward. The M939 is the first truck in the US Army to be fitted with the new STE/ICE diagnostic equipment, which is also installed in the M1 Abrams MBT and the M2 Bradley IFV. This plug-in system allows the crew to locate faults quickly before the vehicle becomes seriously damaged.

As usual there is a complete family of vehicles based on the same M939 chassis. The M923 is a cargo truck with drop sides, while the M924 is the standard cargo truck with drop tailgate and is the equivalent of the old M814. The M925 is the dropside cargo truck with winch, while the M926 is the basic cargo truck with winch. The M927 is the long-wheelbase cargo truck, and when fitted with a front-mounted winch this is known as the M928. The dump truck is the M929, and when fitted with a winch this becomes the M930. The tractor truck M931 is used to tow semi-trailers carrying vehicles and engineer equipment, and when fitted with a winch the model is called the M932. The M933 is the tractor/wrecker with winch, while the M934 has an expanding body, the version with a winch being the M935. The M934 and M935 are used for a wide range of roles such as workshops and command posts, and when static their sides are pulled out to increase their internal work space. The M936 is the wrecker and is fitted with a hydraulically-operated crane at the rear with a telescopic jib. This version is used to change engines and powerpacks in the field as well as to recover damaged and disabled vehicles; when the crane is being used stabilizers are lowered to steady the entire unit.

In addition to carrying cargo, the basic vehicle is also used to tow the 155-mm (6.1-in) M198 howitzer, and radars such as the AN/TPQ-36 mortar-locating set. Others have their dropsides and tailgates removed to carry specialized containers for use in the command role as well as to carry radars and other sensors. The vehicles are also used to move pallets of supplies, pods of fuel and equipment to enable tanks and other vehicles to be refuelled in forward areas.

As a private venture AM General Corporation has designed the Enhanced Mobility System for both the M809 and M939 series of trucks. This is a central tyre pressure-regulation system operated by the driver and allowing him to change the tyre pressure to suit the ground being crossed: for example, for movement on roads the tyres would be at maximum pressure, while for travel on sand they would be deflated to give the tyre more contact area with the ground and therefore greater mobility.

This version of the M809 series of 5-ton 6×6 trucks is used to carry and launch the Ribbon Bridge. This vehicle is carrying a standard folded-bay unit. In action, the truck would back into the water, where the unit slides off the rear and automatically unfolds.

The recovery member of the M809 family of 5-ton 6×6 tactical trucks is the M816. On the rear is a turntable fitted with a hydraulic crane with an extendable jib. When heavy vehicles are being lifted two stabilizers are lowered on each side for additional stability.

AUSTRALIA

International 5000-kg 6×6 truck

After the end of World War II the Australian Army had sufficient vehicles on hand to meet its immediate requirements. Then in the 1950s International Harvester of Australia and the Army Design Department collaborated on two new vehicles which would meet most of the army's heavier requirements. These were the **International 2500-kg** (5,512-lb) 4×4 and the **International 5000-kg** (11,023-lb) 6×6 vehicles which shared a number of common components such as cabs. Production of the 6×6 model started in 1966 and continued until 1974, by which time just over 1,400 had been completed.

The basic cargo truck is designated the **Truck, Cargo, 5-ton, General Service, F1**, while the dump truck model is called the **Truck, Dump, 5 cubic yard, General Service, F2**. In both models the engine is mounted under the forward control cab and is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. The front suspension consists of semi-elliptical springs with double-acting hydraulic shock absorbers, while the rear suspension consists of a multi-leaf six-rod tandem. Steering is of the semi-reversible cam and twin-lever type on the front axle, the tyres being 12.00×20 all round. The main brakes are two-circuit hydraulic, with one circuit for the second axle and one for the first and third axles. The mechanical parking brake acts on the rear wheels.

The rear cargo area is of steel construction with removable drop sides, tailgate, bench seats, bows and tarpaulin cover. The vehicle can carry a maximum payload of 4536 kg (10,000 lb) cross-country or 6804 kg (15,000 lb) on roads. Mounted to the rear of the cab is a winch which can be used to the front or rear of the vehicle; if this winch is overloaded the engine automatically stops to prevent damage. More recently some models have been fitted with an Abbey hydraulic crane to the rear of the cab to facilitate the loading and unloading of supplies. Before this hydraulic crane is used stabilizers are lowered to the ground on each side of the cab.

As usual there are a number of variants of the International truck to meet the requirements of other arms. The dump truck model has a hydraulically-operated rear tipping body with an air-controlled latch mechanism. For the troop-carrying role bench seats can be quickly fitted down each side and bows and a tarpaulin cover fitted over the top. The recovery model is called the **Truck, Wrecker, Medium, 5-ton, General Service, (5)** and is fitted with twin booms, winches and other recovery equipment. There are also water tankers, a bitumen spreader, a stores/box body version, a firefighting vehicle and an earth auger.

To replace the International 4×4 and 6×6 vehicles the Australian Army had two extensive competitions which resulted in the selection of the Mercedes-Benz 4×4 U 1700 L to meet the 4000-kg (8,818-lb) requirement and a Mack 6×6 truck to meet the 8000-kg (17,637-lb) requirement. Variants of the latter will include cargo, dump truck, water tanker, fuel tanker, tractor for the 155-mm (6.1-in) M198 howitzer, recovery vehicle, cement mixer, bitumen spreader and ammunition-carrying vehicles.

Specification
International 5000-kg
Crew: 1+1
Weights: empty 6780 kg (14,947 lb); loaded (cross-country) 11316 kg (24,947 lb)
Powerplant: one International AGD-282 6-cylinder petrol engine developing 111.9 kW (150 hp)
Dimensions: length 6.909 m (22 ft 8 in); width 2.438 m (8 ft 0 in); height (cab) 2.616 m (8 ft 7 in)
Performance: maximum road speed 77 km/h (48 mph); maximum range 483 km (300 miles); gradient 60 per cent; side slope 30 per cent; fording 0.914 m (3 ft 0 in)

Australian infantry dismount from their International Harvester 2500-kg (5,515-lb) 4×4 trucks. Between 1959 and 1971 over 2,300 of these were built in Australia.

An Australian International Harvester 2500-kg (5,515-lb) 4×4 truck with bows and tarpaulin cover in place.

JAPAN

Isuzu Type 73 3500-kg 6×6 truck

In the early 1950s the Isuzu Motor Company built a 6×6 truck almost identical in appearance to the American 2.5-ton 6×6 vehicle used during World War II, and this was subsequently placed in production to meet the requirements of the US forces stationed in Japan and of the Japanese Ground Self-Defence Force. The original model was the **TW**, later models being designated **TWD 20** and **TWD 25**; all of these could carry 2500 kg (5,512 lb) of cargo across country or 5000 kg (11,023 lb) of cargo on roads, and were built with single or dual rear wheels. In addition to the basic cargo model there are many specialized versions including a dump truck which can also be used to carry cargo, an air compressor, water and fuel tankers, recovery vehicles, shop vans for many applications, and a long-wheelbase cargo truck.

These Isuzu 2500-kg (5,512-lb) 6×6 trucks are now being replaced by the **Isuzu Type 73** truck, which can carry 3500 kg (7,716 lb) across country or 6000 kg (13,228 lb) on roads. The type is also used for towing a wide range of weapons, such as 105-mm (4.13-in) howitzers and twin 35-mm anti-aircraft cannon. The Type 73 has a forward control cab with a soft top, and the cargo area at the rear is provided with a drop tailgate, removable bows and a tarpaulin cover. The engine is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. Suspension front and rear consists of semi-elliptical springs and hydraulic shock absorbers. Tyres are 9.00×20 all round, the rear axles having single tyres.

Variants of the Type 73 truck include a shop van with a fully-enclosed rear body, light wrecker with turntable-mounted crane at the rear, fuel tanker, water tanker, cargo truck with hydraulic crane mounted to the rear of the cab for unloading purposes, fire-control vehicle, and a dump truck. There is also a carrier for the Tan-SAM surface-to-air missile system: one vehicle carries four missiles in the ready-to-launch position, while another acts as the fire-control centre. Both of these versions are fitted with hydraulically-operated stabilizers that are lowered to the ground before the system becomes operational.

As previously mentioned, the 2500-kg (5,512-lb) trucks are now being replaced by the 3500-kg (7,716-lb) vehicles. The other standard truck of the Japanese Ground Self-Defence Force is the old **Hino 6×6 series**, which can carry 4000 kg (8,818 lb) of cargo across country or double this amount on roads. These vehicles are of conventional appearance, with the engine at front, the soft-top cab in the centre and the cargo area at the rear. As usual there are many variants, including the **Type 67 Model 30** rocket-launcher and its associated rocket resupply vehicle.

A Type 73 3500-kg (7,716-lb) 6×6 truck of the Japanese Ground Self-Defence Force tows an old American 105-mm M101 howitzer. This vehicle was designed by Isuzu Motors as the replacement for the older Isuzu 6×6 truck, which had a cross country payload of 2500 kg (5,511 lb).

Specification
Type 73
Crew: 1+1
Weights: empty 6640 kg (14,639 lb); loaded (cross-country) 10140 kg (22,355 lb)
Powerplant: one Model 8PA V-8 diesel developing 130.5 kW (175 hp)
Dimensions: length 6.67 m (21 ft 10.6 in); width 2.41 m (7 ft 10.9 in); height (overall) 3.02 m (9 ft 10.9 in)
Performance: maximum road speed 90 km/h (56 mph); maximum range 500 km (311 miles); gradient 60 per cent; side slope 30 per cent; fording 0.8 m (2 ft 7.5 in)

POLAND

Star 266 3500-kg 6×6 truck

It is often thought that non-Soviet members of the Warsaw Pact rely on the Soviet Union to supply all of their ground forces' equipment, but in the case of infantry weapons and trucks this is far from the truth. For many years the Starzchowice Motor Vehicle Plant in Poland has been supplying large numbers of 6×6 trucks, not only to the Polish armed forces but also for the export market. From 1960 the **Star 66** 6×6 became the standard vehicle in its class in the Polish army, and could carry 2500 kg (5,512 lb) of cargo across country or 4000 kg (8,818 lb) of cargo on roads. In the 1960s the **Star 660 M1** and later the **Star 660 M2** appeared with minor improvements. All of these were powered by a petrol engine, but the **Star 660D** was powered by a diesel engine more efficient than the earlier petrol engines.

In 1971 the Starzchowice Motor Vehicle Plant built the prototype of the **Star 266** 6×6 truck which entered production in 1976. This was a major improvement over the earlier vehicles as it can carry 3500 kg (7,716 lb) of cargo across country or 5000 kg (11,023 lb) on roads, the maximum towed load being 4000 kg (8,818 lb).

The diesel engine is mounted under the all-steel fully-enclosed cab and is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. The main brakes are hydraulic, the parking brake being mechanical and acting on the rear wheels. Tyres are 12.00×20 all round, and a central tyre pressure-regulation system is fitted as standard on all vehicles. The cab is provided with a heater, a winch with a capacity of 6000 kg (13,228 lb) is fitted, and the rear cargo area has a drop tailgate, removable bows and a tarpaulin cover.

As there were many variants of the earlier Star 66, Star 660 M1 and Star 660 M2 series of trucks, including tankers, cranes, repair vehicles and decontamination vehicles (plus box bodies for repair, command and communications adaptations), it can be expected that there are or will be similar models of the Star 266.

In Hungary it is Csepel which produces trucks for the Hungarian army, the **Csepel D-566** 5000-kg (11,023-lb) 6×6 truck being the most common. This has a fully-enclosed forward control cab and, at the rear, the cargo area which is provided with drop tailgate, removable bows and a tarpaulin cover. The D-566 is powered by a Raba-MAN six-cylinder diesel developing 200 hp (149.1 kW) and coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. Standard equipment includes a central tyre pressure-regulation system and a winch. Known variants of this vehicle include a shop van with a fully-enclosed rear body, and a recovery vehicle.

For many years the Star 66 2500-kg (5,511-lb) truck was the standard vehicle in its class in the Polish army. Later production models had a fully-enclosed cab, increased fording capability and finally a diesel engine for greater fuel economy.

Specification

Star 266
crew: 1+2
Weights: empty 7200 kg (15,873 lb); loaded (cross-country) 10700 kg (23,589 lb)
Powerplant: one S-359 6-cylinder diesel developing 111.9 kW (150 hp)
Dimensions: length 6.80 m (22 ft 3.7 in); width 2.50 m (8 ft 2.4 in); height (cab) 2.64 m (8 ft 7.9 in)
Performance: maximum road speed 86 km/h (53 mph); maximum range 800/1000 km (497/621 miles); gradient 76 per cent; side slope 30 per cent; fording 1.8 m (5 ft 10.9 in)

USSR

Ural-375D 4000-kg 6×6 truck

In 1961 the Ural Motor Vehicle Plant started the manufacture of the **Ural-375** 6×6 truck, which had an open cab roof (that could be covered by a canvas top) and a stake-type rear cargo body with a drop tailgate. This was followed by the **Ural-375A** which had an all-steel fully-enclosed cab and a number of automotive improvements. Produced in the largest numbers, however, was the **Ural-375D** which can carry 4000 kg (8,818 lb) of cargo across country and 4500 kg (9,921 lb) on roads, the maximum towed loads being 5000 kg (11,023 lb) and 10000 kg (22,046 lb) respectively. The vehicle uses many automotive components of the **Ural-377** 6×4 series of truck that includes the **Ural-377M** with a central tyre pressure-regulation system for use by the Soviet army and the **Ural-377S** tractor truck for towing semi-trailers. These vehicles are used by the Soviet army where all-wheel drive is not considered essential as they are more fuel efficient on roads than the all-wheel drive trucks.

The all-steel fully-enclosed three-man cab has a heater, and the rear cargo area is provided with a drop tailgate, bows and a tarpaulin cover. As with the ZIL-131 truck, hinged seats are provided down each side of the cargo area to enable troops to be carried. The engine is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. As with most Soviet trucks, the engine is fitted with a pre-heater so that it can be started in very low temperatures. Tyres are 14.00×20 all round, with a central tyre pressure-regulation system fitted as standard.

As usual there are a host of specialized versions for civil and military applications, these variants including the **Ural-375N** with drop sides which enables rapid loading and unloading with the aid of forklift trucks, special models for operating in very cold climates or the tropics, tank and fuel resupply vehicles, and a recovery truck; the type can also be fitted with the usual fully-enclosed boxed body which is used for every conceivable role from command centre to field workshop, and can also be used for carrying pontoons and multiple rocket-launchers such as the 122-mm (4.8-in) BM-21 40-round system.

The most interesting version is the **TMS-65** decontamination vehicle, which is the basic vehicle with its cargo body replaced by a modified jet engine (at the very rear) and tanks for the jet fuel and decontamination liquid (to the cab rear). When in position armoured vehicles are driven slowly past the TMS-65 which decontaminates the vehicle. The TMS-65 also tows a trailer with 4000 litres (880 Imp gal) of decontamination solution.

The latest member of the family to enter production is the **Ural-4320** 6×6 4500-kg (9,921-lb) truck, which has a more powerful V-8 diesel that not only gives a higher speed but also greater range of action and increased payload. Variants of the Ural-4320, which is in service with the Soviet army, include the **Ural-4420** 6×6 tractor truck, **Ural-43202** truck with central tyre pressure-regulation system, and the **Ural-44202** tractor truck which also has a central tyre pressure-regulation system.

Among the many versions of the Sovet Ural-375D 4000-kg (8,818-lb) truck are various tankers, some of which are fitted with up to four reels and hoses to enable them to refuel trucks and armoured fighting vehicles in the forward battlefield area.

Specification
Ural-375D
Crew: 1+2
Weights: empty 8400 kg (18,519 lb); loaded 12400 kg(27,337 lb)
Powerplant: one ZIL-375 V-8 petrol engine developing 134.2 kW (180 hp)
Dimensions: length 7.35 m (24 ft 1.4 in); width 2.69 m (8 ft 9.9 in); height 2.68 m (8 ft 9.5 in)
Performance: maximum road speed 75 km/h (47 mph); maximum range 650 km (404 miles); gradient 60 per cent; side slope 30 per cent; fording 1.0 m (3 ft 3.4 in)

A Ural-375D 4000-kg (8,818-lb) truck with bows and tarpaulin cover removed. Cargo is loaded via drop down rear tailgate. Vehicles fitted with a 7000-kg (15,432-lb) winch are called the Ural-375T.

USSR

ZIL-131 3500-kg 6×6 truck

Late in 1966 the **ZIL-131** 3500-kg (7,716-lb) 6×6 truck entered production at the Likhachev Motor Vehicle Plant in Moscow as the replacement for the older **ZIL-157** 2500-kg (5,512-lb) 6×6 truck which had been developed in the late 1950s and was in turn based on the **ZIL-151** 6×6 truck which had been produced from 1947 to 1958. The ZIL-131 is used for a wide range of roles by the Soviet armed forces and by the many other countries that receive Soviet aid. The type shares many components with the **ZIL-133** 6×4 truck, which is used for both civil and military applications.

The ZIL-131 can carry 5000 kg (11,023 lb) of cargo on roads or 4000 kg (8,818 lb) across country, the maximum towed loads being 6500 kg (14,330 lb) and 4000 kg (8,818 lb) respectively. The engine is located at the front of the vehicle and is coupled to a manual gearbox with five forward and one reverse gear and a two-speed transfer case. The front suspension consists of semi-elliptical springs with hydraulic shock absorbers, while the rear suspension consists of an equalizer arm on longitudinal semi-elliptical springs. Tyres are 12.00×20 all round, with a central tyre pressure-regulation system fitted as standard. The all-steel fully-enclosed cab has a heater as standard. The rear cargo area consists of a wooden platform with drop tailgate, removable bows and a tarpaulin cover. To enable the vehicle to be converted quickly for use in the troop transport role, hinged bench seats are fitted down each side of the rear cargo area. All vehicles are fitted with a 4500-kg (9,921-lb) capacity winch.

The ZIL-131 is used for a wide range of roles in addition to its basic tasks of carrying cargo and towing artillery and other weapons. The **ZIL-131D** is a dump truck, while the **ZIL-131V** is used to tow semi-trailers. The **ARS-14** is a special decontamination vehicle which can be used to fight fires as well as to decontaminate vehicles, weapons and other equipment. The chassis is also used to mount a wide range of fully-enclosed box bodies for use in the command, communications, transport and repair roles, while there are also many tankers (fuel and water) and fuel service trucks to refuel vehicles in the forward areas. One of the more interesting versions is the **MA-41** tanker which carries diesel fuel, oil, water and petrol, the diesel and water tanks being provided with heaters so that vehicles can be resupplied even in the coldest weather. The chassis has also been used to mount the 140-mm (5.51-in) BM-14-16 and 122-mm (4.8-in) BM-21 multiple rocket-launchers.

The ZIL-131 3500-kg (7,716-lb) cargo truck was the replacement for the ZIL-157 vehicle. It is widely used as a prime mover for 122-mm guns and for mounting multiple rocket launchers such as the 122-mm BM-21.

Missile batteries have to be resupplied in the forward area, and to this end the ZIL-131 has been modified to carry the SA-6 'Gainful' and SA-3 'Goa' missiles. In the former case three missiles are carried with a foldable crane mounted at the rear of the truck to enable the vehicle to resupply the SA-6 'Gainful' launcher without external assistance. The SA-3 'Goa' resupply vehicle has two missiles, which are winched on to the SA-3 launcher.

Specification
ZIL-131
Crew: 1×2
Weights: empty 6700 kg (14,771 lb); loaded (cross-country) 10425 kg (22,983 lb)
Powerplant: one ZIL-131 V-8 petrol engine developing 111.9 kW (150 hp)
Dimensions: length 7.04 m (23 ft 1.2 in); width 2.50 m (8 ft 2.4 in); height (cab) 2.48 m (8 ft 1.6 in)
Performance: maximum road speed 80 km/h (50 mph); maximum range 525 km (326 miles); gradient 60 per cent; side slope 30 per cent; fording 1.4 m (4 ft 7.1 in)

A ZIL-131 3500-kg (7,716-lb) 6×6 cargo truck shows cross-country mobility. All vehicles have a central tyre pressure system, a winch with a capacity of 4500 kg (9,921 lb), a fully-enclosed cab with heater, and an engine heater.

Wheels of War

The ferocious intensity of modern armoured warfare cannot be maintained for more than a few days without vast quantities of fresh supplies. More than ever before, the logistics system is the lifeblood of an army.

After years of neglect the US Army is at last engaged in a major programme to replace many of its tactical vehicles that are over 20 years old. Shown here are M35 2.5-ton 6×6 and M809 5-ton 6×6 trucks.

In any future conflict in Europe, logistics will play an important if not deciding part. Events in Middle Eastern conflicts have shown that the side which can keep its forward units best supplied with ammunition, fuel, food and other essential supplies has a decided advantage over its opponent. While the Warsaw Pact armies have a high degree of standardization in their tactical vehicles, there is little if any standardization within NATO. This is mainly because all of the major NATO countries (including the UK, USA, Netherlands, France, West Germany, Italy and Spain) have large automotive industries that can provide virtually all of the home user's requirements. In many cases these companies export military and civilian trucks on a wide scale and some of them (for example Renault of France and Pegaso of Spain) also build wheeled armoured vehicles. Within this short space it is impossible to cover every member of NATO, so only West Germany, the UK and the USA are discussed here.

West Germany

In the last few years the West German army has been re-equipped almost completely with new tactical transport vehicles, all of which have been supplied by companies of the West German automotive industry including MAN, Mercedes-Benz and Magirus Deutz. The so-called second generation includes the vehicles in Categories I, II, III and IV. A total of 8,385 Category I vehicles was built by MAN between 1976 and 1981 in 4×4, 6×6 and 8×8 configurations. These vehicles have very high cross-country mobility and have been designed to keep up with forward units. Wherever possible they use standard automotive components and many are fitted with winches for self-recovery and with hydraulic cranes for loading and unloading stores. A few of the MAN 8×8 trucks have been supplied to the Canadian Armed Forces, and in 1984 one of these undertook a cross-country race with a Leopard 1 MBT tank, the truck winning the race! The Category III vehicles are of 4×4 and 6×6 configurations, while the Category IV vehicles, which are used in the rear areas, are 4×2 and 6×4 configuration as it is not expected that they will have to cross rough country.

United Kingdom

This country has almost completed its modernization programme for its B (soft skinned) vehicle fleet. There are three main types in the British Army fleet: high mobility, medium mobility and low mobility. The only high-mobility vehicle in the fleet is the Alvis Stalwart 6×6 amphibian truck, which uses many automotive components of the Saracen APC and Saladin armoured car built from 1966 to 1971. At present there are no plans to replace this essential vehicle, which is used in forward areas to carry refuelling pods and to bring up ammunition to tank and artillery units. The medium-mobility vehicles include the Bedford 4-tonne and 8-tonne 4×4 trucks and the Foden 6×6 vehicles used with the 155-mm (6.1-in) FH-70 howitzer. All of these are standard commercial vehicles modified with all-wheel drive, military type bodies and other small changes to suit them for military use. In the future it is expected that there will be introduced a 14-tonne truck which will share many common components with the Bedford 8-tonne TM 4-4, of which over 2,000 have been ordered by the British army. Low-mobility vehicles include 4×2 Bedfords and 6×4 and 8×4 Fodens, with some 1,300 Fodens already in service. At present the low-mobility vehicles take the ammunition and other supplies from rear area depots up towards the FLOT (Forward Line Of Troops), where loads are then transferred to medium-mobility vehicles to be taken as far forward as possible. If the stores are on pallets then they can be quickly reloaded onto the other vehicles; if they are not the transfer is a time-consuming job.

Currently being tested by the British Army of the Rhine (BAOR) is a revolutionary system called DROPS (Demountable Rack Off-loading and Pick-up System). This consists essentially of a platform on the rear of a cross-country truck which can carry not only pallets of ammunition and other supplies, but also containers, box bodies, refuellers and so on. These can be quickly offloaded without any external assistance, leaving the truck to return to the rear for another load. This allows a smaller number of vehicles to carry out more work.

The British Army has fitted some of its Bedford MK 4000-kg (8,818-lb) 4×4 trucks with snow ploughs for use in Norway, where British units of the Allied Mobile Force (AMF) train every year.

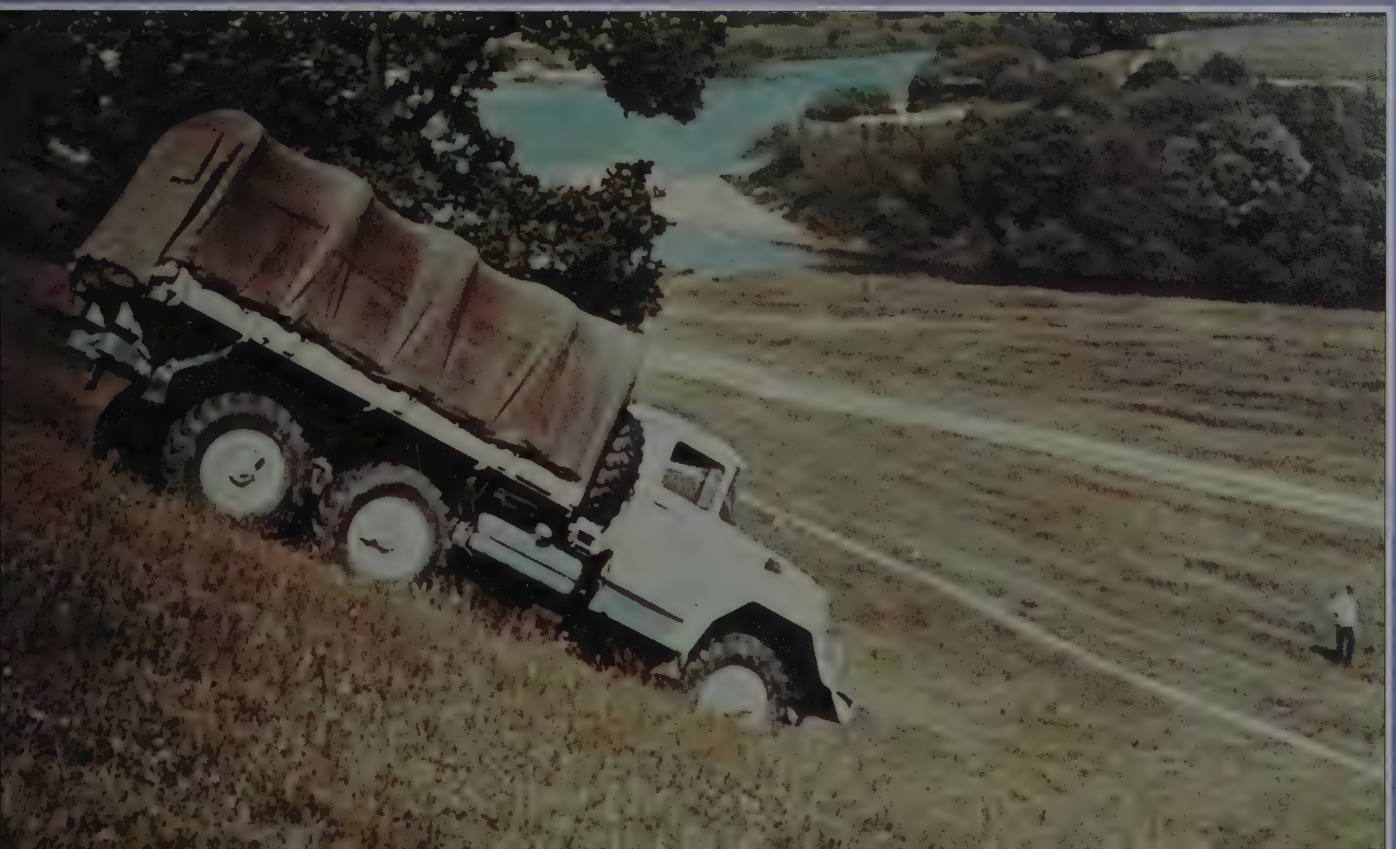
United States

For many years logistics have been rather neglected by the US Army, but in recent years a start has at last been made in providing new vehicles. The 2.5-ton and 5-ton 6×6 trucks are still the backbone of the tactical transport fleet. The total requirement is some 160,000 vehicles, though the actual number is well under this figure. For many years the only vehicle with a good cross-country capability was the GOER 4×4 series, of which 1,300 were built between 1972 and 1976. Now entering service is the so-called Heavy Expanded Mobility Tactical Truck, an 8×8 vehicle built by Oshkosh. In addition to the basic cargo version, which can carry 9979 kg (22,000 lb), tanker, tractor truck and recovery variants are also being procured. The first order was for 2,140 vehicles against a total requirement of some 7,490. The first HEMTTs have already been deployed to Europe, where one of their first tasks is to support the Multiple Launch Rocket System (MLRS).

A common feature of most all-wheel drive trucks in service with the Soviet army, such as this Ural-375D, is its tyre pressure regulation system, but in wartime the army would take over many civilian trucks with little cross-country mobility.

The US Army has realized that its armoured vehicles and artillery will have to be supplied as far forward as possible, for otherwise they will have to withdraw to the rear. With this in mind full-tracked armoured vehicles are now being developed which will be able to operate with the forward units. The first of these is the M992 Field Artillery Ammunition Support Vehicle (FAASV), which backs up to the rear of an M109 155-mm self-propelled howitzer and transfers new ammunition with the aid of a conveyor belt. Over 100 155-mm projectiles, charges and fuses can be carried by this vehicle.

An M809 series 5-ton 6×6 truck of the US Army fords a river without its unit of the Ribbon Bridge. The Army has developed a pallet which enables these trucks to carry stores when not required to carry their Ribbon Bridge units.



Warsaw Pact

Although some Warsaw Pact countries, for example Czechoslovakia, build their own tactical transport vehicles, most of them are supplied by the Soviet Union, this process ensuring a great deal of commonality together with its obvious cost, training and repair advantages. Almost all front-line vehicles used by the Soviet army have 6×6 drive and are fitted with a central tyre pressure-regulation system for improved cross-country mobility. In the event of war, however, the Soviet army fleet would be augmented by many civilian vehicles, some with all-wheel drive but many of 6×4 or 4×2 configuration. When the Soviet Union invaded Afghanistan at the end of 1979, many civilian vehicles were employed in carrying supplies from the Soviet Union through to Kabul in Afghanistan. In time of war in Europe, Allied tactical air forces would attack roads and railways, so forcing the trucks to travel across country, where they travel much more slowly and consume more fuel. So far the Warsaw Pact nations do not appear to have fitted many of their vehicles with small cranes so that they can unload themselves without any external assistance, and thus unloading ammunition and other essential supplies could well take a long time.

It should also be remembered that in the event of a Warsaw Pact invasion of western Europe, the Soviet supply line would get progressively longer while NATO's would get shorter. Some NATO countries are known to have only enough supplies of ammunition for a few days of hard fighting, and again events in the Middle East have shown that the amount of ammunition and missiles used in the first few days of combat have generally been far above those anticipated in peacetime exercises.

There are known instances of tank units running out of ammunition as the trucks carrying their ammunition not only lacked cross-country mobility but were hit by enemy shell fire and destroyed because they had no armour protection.

Logistics can also be taken to include the repair and recovery of damaged and disabled vehicles on the battlefield. The object of the NATO forces is to repair the vehicles as far forward as possible so they can quickly return to the fight. NATO forces are equipped with excellent recovery vehicles based on MBT and other tracked vehicle chassis which are far superior to any armoured recovery vehicles used by the Warsaw Pact. For many years Warsaw Pact armoured recovery vehicles were based on obsolete tank chassis and limited to towing operations only. Almost all NATO ARVs are fitted not only with winches to recover disabled vehicles but also with cranes for changing engines and powerpacks.

A Soviet Ural-375D series 6×6 truck moves across country. In very general terms the Soviets have not put as much emphasis on keeping their forward elements supplied as have their Western counterparts.

West German Army MAN high-mobility vehicles plough across rough terrain during durability trials. Of all NATO countries, West Germany has the most well-equipped and up-to-date range of trucks. The US Army uses MANs as part of the ground-launched cruise missile system.

A convoy of NATO trucks winds its way forwards. In time of war many roads would be damaged by Soviet aircraft or blocked by escaping civilians; it is therefore essential that as many NATO trucks as possible have good mobility across country.

UK

Bedford MK 4000-kg 4×4 truck

In the early 1950s the British army selected the **Bedford RL** 4×4 vehicle as one of its standard 3000-kg (6,614-lb) trucks, although in 1968 it was uprated to 4000 kg (8,818 lb). By the time production of the RL was completed in 1969 over 70,000 had been built for both civil and military applications, and many of the vehicles had been exported. Even in 1985 many RLs remain in service with the British armed forces.

In the 1960s a competition was held to find a successor to the RL, and after exhaustive tests with prototype vehicles submitted by Austin, Commer and Vauxhall, the last was selected. This was called the **Bedford MK** and based on the civil 4×2 TK truck chassis, though the many modifications for military use included a different engine, all-wheel drive, larger tyres, military lighting and stowage. In 1985 the MK remains in production for both military and civilian applications, some 37,000 having been built for the home and export markets. The MK can carry 4530 kg (9,987 lb) across country, and can tow a trailer weighing up to 5080 kg (11,199 lb).

The MK has an all-steel fully-enclosed forward control cab, and many vehicles are provided with a roof opening on which a 7.62-mm (0.3-in) machine-gun can be fitted to provide low-level air defence. The rear cargo body is built and fitted by Marshall of Cambridge, and has drop sides and tailgate, removable bows and a tarpaulin cover. The basic model is powered by a Bedford six-cylinder diesel developing 103 bhp (76.8 kW), but a number of other engines are also offered, such as a six-cylinder petrol engine and a six-cylinder turbocharged diesel. The engine is coupled to a manual gearbox with four forward and one reverse gear and a two-speed transfer case. Suspension, front and rear, consists of semi-elliptical springs with hydraulic shock absorbers.

The MK can be fitted with a wide range of optional equipment to suit almost every conceivable operator requirement, including a winch with a capacity of 3500 kg (7,716 lb), single or rear dual wheels, troop seats down each side of the cargo area, a five-speed gearbox, stowage racks for equipment and rifles, and power-assisted steering.

For carrying cargo on pallets the dropsides and tailgate can quickly be removed, and to assist in the loading and unloading of cargo many vehicles have been fitted with a hydraulic crane to the cab rear. The MK can also carry the CB 300 container, which is used for many roles including specialist repair for forward units. It is also used to carry the Gloster Saro demountable bulk fuel dispensing unit to refuel vehicles and helicopters in forward areas. Other MKs are used to carry portable trackways, and to serve as aircraft refuellers and recovery vehicles, and so on. The TK 4×2 version is widely used for carrying stores in rear areas and for driver training as they are more fuel efficient than the 4×4 trucks.

The Bedford MK 4000-kg (8,818-lb) 4×4 truck was introduced into the British Army as the replacement for the earlier Bedford RL truck, which had previously been uprated from 3000 kg (6,614 lb) to 4000 kg (8,818 lb).

Right: The Bedford MK 4000 kg (8,818 lb) 4×4 truck is the standard vehicle in its class in the British Army. This Bedford is fitted with a communications cabin with its generator to the immediate rear of the three-man cab.

Specification

MK
Crew: 1+1
Weights: empty 5120 kg (11,287 lb); loaded (cross-country) 9650 kg (21,274 lb)
Powerplant: one Bedford 6-cylinder diesel developing 76.8 kW (103 bhp)
Dimensions: length 6.579 m (21 ft 7 in); width 2.489 m (8 ft 2 in); height (cab) 3.404 m (11 ft 2 in)
Performance: maximum road speed 77 km/h (48 mph); maximum range 560 km (348 miles); gradient 49 per cent; side slope 25 per cent; fording 0.76 m (2 ft 6 in)

SPAIN

Pegaso 3055 6000-kg 6×6 truck

Pegaso is the leading truck builder in Spain, and it was natural that the Spanish army should turn to this company for its trucks. For many years the Spanish army used mainly American 2.5- and 5-ton trucks (and many of these remain in service today) but Spain, in common with many other countries, wanted to become more independent of its outside suppliers. This was not only for political reasons, but also to build up its own technological bases, to save on foreign exchange costs and, if possible, to bring in foreign exchange through exports. Thus Pegaso initially built an improved model of the Dutch DAF YA 414 called the **Pegaso 3045**: the first vehicles were built mainly of components supplied by DAF, but gradually the local content increased and in the end almost all of the vehicle was built in Spain. The Pegaso 3045 could carry 3000 kg (6,614 lb) of cargo across country and 6000 kg (13,228 lb) on roads. The **Pegaso 3050** 6000-kg (13,228-lb) truck has the same cab as the 3045, and in addition to being used as a cargo truck is also employed to tow artillery and semi-trailers, mount multiple rocket-launchers and serve as a recovery vehicle.

The latest Spanish truck is the **Pegaso 3055** 6×6 vehicle, which can carry 6000 kg (13,228 lb) of cargo across country or 10000 kg (22,046 lb) on roads. The cab is at the front of the vehicle, and has a forward-folding windscreen and a removable canvas top. The engine, which is mounted at the front of the vehicle, is coupled to a manual gearbox with six forward and one reverse gear and a two-speed transfer case. Suspension, front and rear, consists of semi-elliptical leaf springs, the front units having hydraulic shock absorbers. The rear cargo area has a drop tailgate, removable bows and a tarpaulin cover, and bench seats are provided for 30 troops. The vehicle can tow a trailer or weapon weighing up to 14500 kg (31,967 lb) on roads or 7500 kg (16,535 lb) across country, and optional equipment includes a winch with a capacity of 6000 kg (13,228 lb).

Variants of the Pegaso 3055 include a tipper or dump truck, a recovery vehicle and a tanker, while there are box bodies for specialized roles such as workshop, command and food carrier.

Specification

Pegaso 3055
Crew: 1+1
Weights: empty 9000 kg (19,842 lb); loaded (cross-country) 15000 kg (33,069 lb)
Powerplant: one Pegaso Model 9220/10 6-cylinder diesel developing 164.1 kW (220 hp)
Dimensions: length 7.00 m (22 ft 11.6 in); width 2.40 m (7 ft 10.5 in); height (cab) 2.765 m (9 ft 0.9 in)
Performance: maximum road speed 80 km/h (50 mph); maximum range 550 km (342 miles); gradient 51 per cent; side slope 30 per cent; fording 1.0 m (3 ft 3.4 in)

For many years the Pegaso 3045 3000-kg (6,614-lb) truck was the standard vehicle in its class in the Spanish army. A special model called the 3045DV was built to meet the requirements of the Spanish marines, and this can ford to a maximum depth of 2 m (6 ft 7 in).

WEST GERMANY

Mercedes-Benz U 1300 L 2250-kg 4×4 truck

Mercedes-Benz Model U 1300 L 4×4 truck of the West German army with bows and tarpaulin covers removed. This truck can also tow a trailer or weapon weighing a maximum of 8500 kg (18,739 lb). An ambulance version with enclosed rear body is also in service.

After the end of World War II the **Mercedes-Benz Unimog** truck was designed for industrial and agricultural use, and this entered production in 1949. Since then the vehicle has been continuously developed until it now comprises a complete family of 4×4 vehicles with exceptional cross-country mobility. In the last 30 years or so it has been adopted by many armed forces, the West German army selecting the **U 1300 L** variant to meet its requirements for a vehicle carrying 2250 kg (4,960 lb) of cargo across country and towing a trailer or weapon weighing up to 8500 kg (18,739 lb). An order for no less than 17,000 vehicles was placed with Mercedes-Benz in 1978, with final deliveries to be made in 1989. The U 1300 L has also been selected by New Zealand, while the Australian army is to receive 1,295 of the heavier **U 1700 L** series, which will be assembled in Australia with some local content.

The U 1300 L used by the West German army is essentially a standard commercial 4×4 vehicle with a number of modifications such as military cargo body with removable sides and tailgate, bow and tarpaulin cover, 24-volt electric system, lashing points, observation hatch in the roof and stowage for personal kit and small arms.

The layout of the U 1300 L is conventional, with the engine at the front, the fully-enclosed cab in the centre and the cargo area at the rear. The all-steel cab is fully insulated and provided with a heater as standard equipment; to allow maintenance access to the engine the cab can quickly be tilted forwards. The engine is coupled to a cascade gearbox with a planetary gear group flanged on the transfer case, giving a total of eight forward and four reverse gears. The suspension consists of semi-elliptical springs and hydraulic shock absorbers, and steering is power-assisted. The latter is often regarded as a luxury, but for extended cross-country driving it must be considered essential as it makes the driver's task a lot easier. If required the vehicle can be delivered with a front-mounted winch. The only variant used by the West German army at present is a fully enclosed ambulance

To give some idea of the roles Unimogs undertake with an army today, it is worth looking at the roles envisaged by the Australian army for its vehicles: of the 1,295 to be delivered by 1987, 858 will be the basic cargo model, 287 cargo vehicles with winches, 76 cargo trucks with cranes for loading and unloading operations, 69 dump trucks with winches, and the remaining five fitted with augers/pole erectors. The Royal Air Force uses short-wheelbase (SWB) Unimogs for towing the BAe Harrier VTOL aircraft when it is deployed in the field. The chassis of the Unimog is also used as the basis for a number of armoured personnel carriers such as the UR 416.

Specification

U 1300 L
Crew: 1+2
Weights: empty 5250 kg (11,574 lb); loaded (cross-country) 7500 kg (16,535 lb)
Powerplant: one Mercedes-Benz OM-352 6-cylinder diesel developing 71.6 kW (96 hp)
Dimensions: length 5.54 m (18 ft 2.1 in); width 2.30 m (7 ft 6.6 in); height (including tarpaulin) 2.83 m (9 ft 3.4 in)
Performance: maximum road speed 80 km/h (50 mph); maximum range 900 km (559 miles); gradient 70 per cent; side slope 30 per cent; fording 1.2 m (3 ft 11.2 in)

Between 1978 and 1987 the West German army is expected to take delivery of some 17,000 of these Mercedes-Benz Model U 1300 L 4×4 Unimog trucks. The model shown here is fitted with a 20-mm anti-aircraft mount in the rear cargo area.

WEST GERMANY

MAN 5000-kg 4×4 truck

In the late 1950s the West German army started to draw up its requirements for a second generation of wheeled vehicles, even though the first generation types were only then entering service. The new range was to include an 8×8 amphibious armoured car which eventually entered service as the Luchs, 4×4 and 6×6 amphibious armoured load carriers (the latter entering production as the Transportpanzer 1 or Fuchs) and a series of 4×4, 6×6 and 8×8 high-mobility cross-country trucks, some of which were required to have an amphibious capability. To develop this range of vehicles two groupings were formed, and in the end Daimler-Benz developed the armoured vehicles (although production was undertaken by Thyssen Henschel) while the Joint Project Office (including MAN) developed the trucks.

Late in 1975 MAN was awarded a contract for 8,385 **MAN 4×4, MAN 6×6** and **MAN 8×8** Category 1 trucks worth over DM1,400 million. The first production vehicles were completed at MAN's facility at Watenstedt in 1976, and final deliveries were made in 1981. The 4×4 model has a nominal payload of 5000 kg (11,023 lb), while the 6×6 version can carry 7000 kg (15,432 lb) and the 8×8 variant is rated at 10000 kg (22,046 lb). The Canadian Armed Forces have a small number of 8×8 vehicles, and the US Army uses the type as part of the ground-launched cruise missile (GLCM) system. The 6×6 model has been produced in Austria by OAF as the **Type 20.320** for the Austrian army, and in this application the model has been upgraded to 10000 kg (22,046 lb).

These vehicles share many common components such as cabs, axles, wheels, tyres and so on, and these are standard commercial parts. The forward control cab can be tilted forward to allow access to the engine for maintenance purposes; an observation hatch is provided in the roof, and if required a 7.62-mm (0.3-in) machine-gun can be fitted here for anti-aircraft defence. The rear cargo area has removable drop sides and tailgate, bows and a tarpaulin cover. Many of the MAN vehicles are fitted with a Rotzler winch. The MAN 4×4 truck is used to carry containers and other specialized bodies, such as the Contraves Fieldguard artillery fire-control system used with the Light Artillery Rocket System (LARS) of the West German army.

The MAN 5000-kg (11,023-lb) 4×4 truck shares many automotive parts with the MAN 6×6 and 8×8 trucks, of which over 8,300 are now in service with the West German army.

Specification

MAN 4×4
Crew: 1+2
Weights: empty 9700 kg (21,385 lb); loaded (cross-country) 14300 kg (31,526 lb)
Powerplant: one MAN V-8 diesel developing 190.9 kW (256 hp)
Dimensions: length 8.02 m (26 ft 3.75 in); width 2.50 m (8 ft 2.4 in); height (cab) 2.86 m (9 ft 4.6 in)
Performance: maximum road speed 90 km/h (56 mph); maximum range 700 km (435 miles); gradient 70 per cent; side slope 30 per cent; fording 1.2 m (3 ft 11.2 in)

Royal Navy Part 2

Destroyers and frigates

The backbone of the Royal Navy is formed by its destroyer and frigate flotillas. The former is constituted by three batches of the Type 42 destroyer that provide the primary anti-air warfare missile defence for the fleet with the twin-rail GWS-30 Sea Dart system. This is a 65-km (40-mile) range Mach-3.5 low/high-altitude SAM that proved itself in the Falklands war; but like a number of other weapon systems used in the Falklands, the GWS-30 system was also found wanting in some key areas. The small number of reload missiles carried by each Sea Dart ship is also a cause for concern because a Soviet saturation attack by aircraft and missiles would swamp the system because (amongst other things) of poor computer/human interface response time and reloading. The ships' ASW armament is minimal, and apart from a 4.5-in (114-mm) gun there is no surface-to-surface capability other than the Lynx helicopter and a secondary role for the Sea Dart system.

The inner zone of point-defence missiles is gradually being switched from the vessels armed with Sea Cat missiles to the Type 22 frigates which provide 'goalkeeper' services to otherwise unprotected high-value surface targets. Armed with the GWS-25 fully automatic Sea Wolf missile system, the Type 22 ships are designed primarily for ASW operations in the Greenland-Iceland-UK (GIUK) gap. However, because of the lessons of the Falklands war the Type 22 Batch 3 vessels of the 14-ship class will carry both a 4.5 (114-mm) gun and two Dutch 30-mm Goalkeeper CIWS (close-in weapon system). The Type 22 Batch 2 and 3 vessels will also carry the Type 3031(Z) towed sonar array, and all three sub-groups will eventually be fitted with the Type 2050 hull-mounted active sonar system. The major disadvantage of the class is the fact that the Sea Wolf launchers are hand reloaded, which makes the ships vulnerable to stream saturation attacks. To rectify this the new Type 23 'Daring' class frigates that are to be ordered in the next year or so will be fitted with the GWS-26 vertical-launch Sea Wolf system. It is possible that the Type 22 Batch 3 ships may also be fitted with GWS-26. Both the Type 22 Batch 3s and the 'Darings' will also be fitted to carry the US Harpoon surface-to-surface anti-ship missile in two quadruple launchers. The Harpoon will replace the current French MM.38 Exocet in that role, and will enable the launch platform to engage surface targets at well over twice the range currently possible with the MM.38. To complement the weapon systems new decoy launchers, ESM (electronic support measures) equipment and active jammers will also be fitted to enhance survivability.

To bolster the modern destroyer and frigate force there are 24 'Leander' class and six Type 21 frigates in service with a diminishing number of older vessels. Since entering service the 'Leanders' have undergone extensive refits that have resulted in six separate sub-groups that vary from the Ikara ASW conversion to the Sea Wolf SAM/Exocet SSM (surface-to-surface missile) conversion in scope. Although at present still numerically the most important of the Royal Navy's surface fleet, the 'Leander' class is gradually to decrease in numbers as the older ships are replaced by new-build vessels. The fate of the six remaining Type 21s is also somewhat of a mystery at present as stability problems mean that they cannot be rearmed with new weapon systems. Most of them also suffered major hull cracking problems when they served in the South Atlantic, so their time in the fleet may well be numbered. One possibility being explored to offset any possible lack of frigates is the design and construction of a number of heavily armed corvettes to operate around the UK's coastal waters and in areas like the West Indies. There are already five 'Peacock' class corvettes in service with the Royal Navy armed with an OTO-Melara Compact 76-mm (3-in) gun and four single 7.62-mm (0.3-in) machine-guns. These were funded mainly by the government of Hong Kong to replace five ex-'Ton' class patrol ships that were used to patrol the colony's waterways. The individual needs of the Falklands have also been met by the purchase and conversion of three ice-strengthened commercial oilfield supply tugs. Named HMS *Sentinel*, HMS *Protector* and HMS *Guardian*, these have now deployed to the South Atlantic to release some of the major surface combatants for NATO duties. They are joined in that duty by the ice patrol ship HMS *Endurance*, whose proposed scrapping in 1982 was a major signal to Argentina that the UK was no longer interested in the Falklands. For coastal patrol around the UK and for fishery protection duties there are seven 'Isles' class, two 'Castle' class and six 'Ton' class minesweepers which operate under the auspices of the Coastal Squadron. Their armament is minimal, but the two 'Castle' craft have a minelaying capability that has been tested in trials.

HMS* Broadsword, *first of the 'Type 22' class frigates, provides 'goalkeeper' protection to the carrier HMS* Hermes. *The fitting of Sea Wolf missiles has made the class potent close air defence vessels.

The Royal Navy's only other surface minelaying capability is provided by the exercise minelayer and MCMV (mine countermeasures vessel) depot ship HMS *Abdiel*. In wartime the laying would be undertaken by requisitioned roll-on/roll-off ferries in the manner of the vessels used by the Libyan navy. Any offensive laying would have to be done by the submarine force or by RAF aircraft such as the BAe Nimrod or Lockheed Hercules. To find and destroy enemy ground mines laid in coastal waters the Royal Navy maintains in service a force of about 15 elderly 'Ton' class minehunters. These are being slowly supplemented by 15 'Hunt' class MCMVs with GRP (glass-reinforced plastics) hulls and the French PAP104 mine-disposal system. The 'Tons' will eventually be replaced by a class of single-role GRP-hulled minehunters that is currently being designed. Conventional minesweeping operations are still being undertaken by a number of 'Ton' class vessels, which are being replaced in RNR service by the 'River' class of fleet minesweeper which was designed specifically to deal with the Soviet continental shelf, deep water rising and underwater electrical-potential mine types that will be sown along NATO submarine transit routes. To assist the regular sweepers in wartime the Royal Navy will requisition some 40 or so deep-sea trawlers that will be equipped with the Extra Deep Armed Team Sweep gear for tackling moored mines at most depths.

Auxiliary ships

To support the fleet the Royal Fleet Auxiliary (RFA) has a wide range of underway replenishment ships and tankers. The Falklands War has seen the reduction of the RFA fleet stopped and has shown the need for its vessels to be armed with both self-defence weapons and ASW stores for the helicopters they carry for VERTREP (vertical replenishment) operations. For the future, a new class of fast combat support ship is under development that will carry Sea Wolf SAMs and an air group of six ASW helicopters together with facilities to service BAe Sea Harrier V/STOL fighter-bombers. In addition to the air-capable replenishment ships the RFA also operates two aviation support ships, the *Reliant* fitted out as the Arapaho concept containerized air support trials ship and the replacement for the current helicopter support ship *Engadine*, the ex-*Container Bezant* which is undergoing a two-year conversion and will carry up to six Westland Sea King-sized helicopters and have the facilities necessary for operating up to 12 Sea Harriers if required. The RFA also crews the five LSLs (landing ships, logistic), and two ex-merchant logistic ships in support of the Royal Marines and British army, each of whom operates a number of LCVPs (landing craft vehicle, personnel), LCU (landing craft, utility) and logistic landing craft for its own use.

There are also in service a considerable number of other support and auxiliary craft such as salvage vessels, tugs, tenders and the like, of which the most important are the *Diligence*, a maintenance and repair ship, and the *Challenger*, a seabed operations vessel. The royal yacht *Britannia* is also included in the navy list with a wartime role of hospital ship, but during the Falklands war she was conspicuous by her absence through fuel-compatibility problems. Her role was undertaken by the liner *Uganda*, with the survey vessels *Hydra, Hecla* and *Herald* serving as ambulance ships.

The Royal Navy's hydrographic service operates four offshore, four coastal and four inshore surveying vessels, which are totally inadequate for the workload assigned to it. Hopefully by the mid-1980s the work performed will be for military purposes only as all the civilian work is to be transferred to the Department of Trade. There is to be a small expansion of the hydrographic service within the foreseeable future as a new coastal survey ship, the *Roebuck*, has been ordered.

The ice patrol ship HMS* Endurance *won a reprieve from the scrapyard as a result of the Falklands war, and so remains to serve the scattered British scientific stations on the coasts and islands of Antarctica.

Seen during a NATO exercise making an underway replenishment of (left) a 'Knox' class frigate of the US Navy and (right) a Canadian 'Iroquois' class destroyer, the 'Rover' class small fleet tanker can carry over 6000 tonnes of fuel products.

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Self-Propelled Guns of World War II

Once Germany had demonstrated the new pace of armoured warfare, most belligerent nations began to develop fully mechanized divisions. Field guns were mounted on tank chassis and a new generation of armoured fighting vehicles was born. Self-propelled guns assumed ever-increasing importance during the war, and today have largely supplanted towed artillery.

Arguably the most famous self-propelled gun of World War II was the Sturmgeschütz III. Entering service in 1940, it served throughout the war in a bewildering multitude of variants, but its aggressive low silhouette often led to its being employed as a cut-price tank.

Self-propelled artillery was very much a product of the type of warfare that evolved during World War II: before 1939 self-propelled artillery scarcely existed (apart from a few trial weapons), but by 1943 it was used by all the combatant nations. The sudden rise of this new form of weapon can be attributed almost entirely to the impact of the battle tank on tactics, for warfare no longer took place at the speed of the marching soldier and the scouting horse, but at the speed of the tank. Tanks swarmed all over Poland, France and eventually the Soviet Union, and the only way that the supporting arms, including the artillery, could keep up with them was to become equally mobile.

Many of the early self-propelled artillery platforms were simply conversions of existing tanks to mount artillery pieces, but the measure of conversion varied widely. Some were scarcely more than 'lash-ups' to meet a hasty requirement or built locally to suit a particular task. Others were carefully designed from the outset and may be regarded as virtually new products. But two distinct trends can be discerned in the way self-propelled artillery was used in action. One school regarded mobile artillery as a simple adjunct to existing artillery doctrines, and this school designed and used the self-propelled platforms to deliver indirect supporting fire in the usual way. The other school regarded the mobile gun as a form of close-range direct-fire weapon to be used in close support of armour, and this school was responsible for the assault gun. Today both types of weapon are extant, but the modern accent is on the indirect-fire weapon in the West and the close-support assault gun in the East.

Only a selection of the many types of self-propelled artillery that proliferated between 1939 and 1945 can be found in this study. Some important types have been omitted, while some 'one-offs' have been included to demonstrate the variety of design concepts that were attempted. The number and approaches of the different designs came to be enormous before 1945, but only relatively few models actually found their way into action. Most of them are covered here.

An M7 is seen in action 'somewhere in Europe' during the harsh winter of 1944-5. This vehicle is typical of the period, being liberally cluttered with extra equipment and ration packs, but the AA machine-gun is manned and the crew are well protected against the weather as they serve the 105-mm (4.1-in) howitzer.

GERMANY

sIG 33 auf Geschützwagen

The German infantry battalions each had a small artillery complement of four 7.5-cm (2.95-in) light howitzers and two 15-cm (5.9-in) infantry howitzers for their own local fire support. The 15-cm howitzer was known as the schwere Infantrie Geschütz 33 (sIG 33, or heavy infantry gun) and was a very useful and versatile weapon, but it was heavy and the only 'equipment' allocated to most infantry formations for the movement of the weapons were horse teams. Thus when an increasing degree of mechanization began to filter through the German army the sIG 33 was high on the list for consideration.

The first form of mobile sIG 33 was used during the French campaign of May 1940. It was one of the simplest and most basic of all the German self-propelled equipments, for it consisted of nothing more than a sIG 33 mounted complete with carriage and wheels on to a turretless PzKpfw I light tank as the **15-cm sIG 33 auf Geschützwagen I Ausf B**. Armoured shields were provided for the crew of four, and that was that. It was not a very satisfactory conversion as the centre of gravity was rather high and the chassis was overloaded. Moreover, the armour protection was not good, and so in 1942 the PzKpfw II was the subject for conversion. This **15-cm sIG 33 auf Geschützwagen II ausf C SdKfz 121** conversion had the howitzer mounted low in the chassis, and was so successful that during 1943 a version with a lengthened hull was produced as the **15-cm sIG 33 auf Fgst PzKpfw II (Sf) Verlänget**.

The ex-Czech PzKpfw 38(t) was also converted to act as a sIG 33 carrier. In 1942 the first of a series of vehicles known collectively as the **15-cm sIG 33 (Sf) auf PzKpfw 38(t) Bison SdKfz 138** were produced. The first series had the sIG 33 mounted forward on the hull top behind an open armoured superstructure, and this weapon/vehicle arrangement proved to be so successful that it was formalized in 1943 by the production of a new version. This was a factory-produced model rather than a conversion of existing tanks and had the vehicle engine mounted forward (instead of at the rear as originally located) this entailing the movement of the fighting compartment to the hull rear. This was the **SdKfz 138/1** (SdKfz for *Sonder Kraftfahrzeug*, or special vehicle) and it was this vehicle that was retained as the German army's standard sIG 33 carrier until the end of the war. The SdKfz 138/1 had a crew of four men including the driver, and 15 shells were carried on the vehicle. There was no room for more because the fighting compartment was rather restricted for space.

There was one other sIG 33 self-propelled version, this time on a PzKpfw III chassis. This **15-cm sIG 33 auf PzKpfw III** appeared in 1941 and used a large box superstructure on a PzKpfw III to house the sIG 33. This proved to be rather too much of a good thing, for the chassis was really too large for the weapon which could be easily carried by lighter vehicles. Thus production never got properly under way, being terminated after only 12 conversions had been made. These vehicles were used in action on the Eastern Front.

All the sIG 33 self-propelled equipments were used for their original role, i.e. the direct fire-support of infantry units in the field. Perhaps the most successful of these self-propelled carriages were the Bison and the later SdKfz 138/1. Over 370 of the vehicles were produced, and they were still in production in late 1944.

One of the first German self-propelled conversions was the mounting of a 15-cm sIG 33 infantry howitzer onto the hull of a PzKpfw I light tank.

Taken from a German newsreel, this shot clearly shows how high and awkward the mounting of the 15-cm howitzer really was on the PzKpfw I chassis. The crew had only limited protection and stowage was minimal, but it provided the Germans with an indication of wha would be required in future.

Specification

SdKfz 138/1
Type: self-propelled infantry-support howitzer
Crew: 4
Weight: 11500 kg (25,353 lb)
Powerplant: one Praga 6-cylinder petrol engine developing 111.9 kW (150 hp)
Dimensions: length 4.835 m (15 ft 10.4 in); width 2.15 m (7 ft 0.6 in); height 2.4 m (7 ft 10.5 in)
Performance: maximum road speed 35 km/h (21.75 mph); maximum road range 185 km (115 miles); fording 0.914 m (3 ft)
Armament: one 15-cm (5.9-in) howit

GERMANY

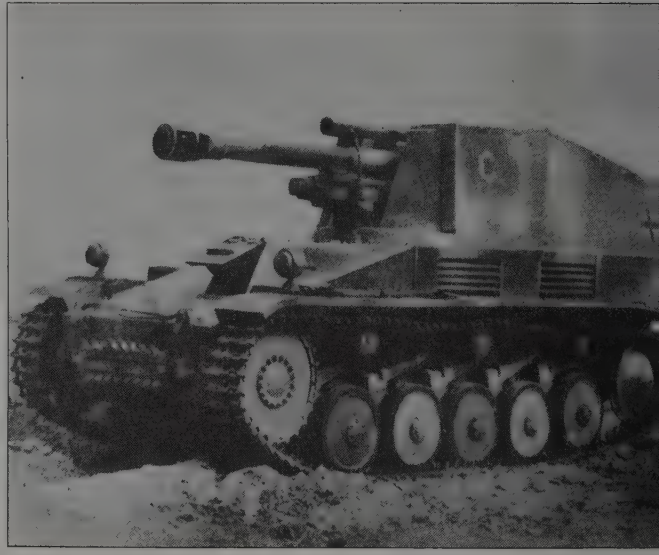
Wespe

Even as early as 1939 it was obvious that the days of the little PzKpfw II tank were numbered, for it lacked both armament and armour. However, it was in production and quite reliable, so when the need arose for self-propelled artillery the PzKpfw II was selected to be the carrier for the 10.5-cm (4.13-in) leFH 18 field howitzer. The conversion of the tank hull to carry the howitzer was quite straightforward, for the howitzer was mounted behind an open topped armoured shield towards the rear of the hull and the area where the turret had been was armoured over and the space used for ammunition stowage. Maximum armour thickness was 18 mm (0.7 in).

The result was the self-propelled howitzer known as the **Wespe** (wasp) though its full official designation was rather more cumbersome: **leFH 18/2 auf Fgst Kpfw II (Sf) SdKfz 124 Wespe**, but to everyone it was just the Wespe. It was a very popular little self-propelled weapon that soon gained for itself a reputation for reliability and mobility. The first of them were based on the PzKpfw II Ausf F chassis and went into action on the Eastern Front during 1943. On this front they were used by the divisional artillery batteries of the Panzer and Panzergrenadier divisions. They were usually organized into batteries of six howitzers with up to five batteries to an *Abteilung* (battalion).

The Wespe was so successful in its artillery support role that Hitler himself made an order that all available PzKpfw II chassis production should be allocated to the Wespe alone, and the many other improvised weapons on the PzKpfw II chassis were dropped or their armament diverted to other chassis. The main Wespe construction centre was the Famo plant in Poland, and there production was so rapid that by mid-1944 682 examples had been built. Some time around that

The SdKfz 124 Wespe was a purpose-built carrier for a 105-mm howitzer based on the chassis of the PzKpfw II light tank. It was first used during 1942 and had a crew of five.



te manufacture of the Wespe
ased, but not before 158 had been
mpleted without howitzers; these
hicles had the gap in the armour
te for the howitzer sealed off, the
ace behind the armour being used
resupply ammunition needed by
teries in the front line.
A typical Wespe went into action
rrying its crew of five, including the
ver, and 32 rounds of ammunition. A
espe battery was completely
bile, although some of the vehicles
re soft-skinned trucks for carrying
munition and other supplies. The
ward observers were usually car-
d in light armoured vehicles
hough some batteries used ex-
ech or captured French tanks for
s purpose. Fire orders were relayed
ck to the battery by radio, and from
e battery fire command post the
ders were further relayed to the gun
sitions by land lines. The howitzer
rried on the Wespe was the stan-
rd 10.5-cm leFH 18 as used by
ved batteries (although most were fitted with muzzle brakes) and so used the same ammunition. They also had the same range of 10675 m (11,675 yards).

Specification
Wespe
Type: self-propelled field howitzer
Crew: 5
Weight: 11000 kg (24,251 lb)
Powerplant: one Maybach 6-cylinder petrol engine developing 104.4 kW (140 hp)
Dimensions: length 4.81 m (15 ft 9.4 in); width 2.28 m (7 ft 5.75 in); height 2.3 m (7 ft 6.6 in)
Performance: maximum road speed 40 km/h (24.85 mph); road range 220 km (137 miles); fording 0.8 m (2 ft 7.5 in)
Armament: one 105-mm (4.13-in) howitzer and one 7.92-mm (0.31-in) MG34 machine-gun

This shot of a Wespe on the move shows that the top of the fighting compartment was open but protection was provided at the rear.

Note how small the vehicle actually was compared to the stature of the gun crew in the compartment.

GERMANY

Hummel

e self-propelled artillery vehicle
t became known as the **Hummel**
umble bee) was a hybrid combining
mponents of the PzKpfw III and
Kpfw IV tanks into a new vehicle
own as the **Geschützwagen III/IV.**
e first of these hybrids was pro-
ced during 1941 and used a leng-
ned PzKpfw IV suspension and run-
g gear combined with the final
ve assemblies, track and transmis-
n of the PzKpfw III. Onto this new
l was built an open superstructure
med with light armour plates, and
o types of weapon were mounted.
hicles intended for use as tank des-
yers mounted a version of the 88-
n (3.46-in) anti-tank gun, but vehi-
s intended for use as self-propelled
illery mounted a special version of
e 15-cm (5.9-in) FH 18 field howitzer.
The FH 18 vehicle was the **15-cm**
nzerfeldhaubitze 18M auf GW III/IV
Kfz 165 Hummel, and it formed the
avy field artillery element of the
nzer and Panzergrenadier divisions
m 1942 onwards. The ordnance was
own as the Panzerfeldhaubitz 18/1,
d could fire a 43.5-kg (95.9-lb) pro-
tile to a range of 13325 m (14,572
rds). The first howitzers produced
the self-propelled role were fitted
th large muzzle brakes, but experi-
ce demonstrated that these were
t really necessary and were accor-
ngly left off later production ver-
ns. Maximum armour thickness was
mm (1.97 in).
The Hummel had a crew of five, in-
uding the driver who sat in an
noured position forward. The provi-
n of an armoured compartment for
e driver alone was considered a lux-
y in war-production terms, but in-
ad of eliminating this feature the de-
mers made the whole thing cheaper
enlarging the armoured position
d employing more flat steel plates.
us more internal space was pro-
ded for one of the crew members.
e Hummel could carry only 18
unds of ammunition so more had to
kept nearby and brought up when
cessary. Trucks were often of little
ue for this task, so by late 1944 no
s than 150 Hummels were produced without the howitzer and the divided front armour plates replaced by a single plate. These vehicles were used as ammunition carriers for the Hummel batteries. By late 1944 no less than 666 Hummels had been produced and the type remained in production until the end of the war. They proved to be useful and popular weapons, and were used on all fronts. Special versions with wider tracks known as Ostkette were produced for use during the winter months on the Eastern Front, and the open superstructures were often covered with canvas tarpaulins to keep out the worst of the weather. The gun crew generally lived with the vehicle, so many Hummels were festooned not only with camouflage of all kinds but also with bed rolls, cooking pots and items of personal kit.

The Hummel was one of the Germans' best examples of purpose-built self-propelled artillery. It had plenty of room for the crews to serve the gun, and the carriage gave the howitzer the desired mobility to keep up with the Panzer divisions.

Above: The Hummel (bumble bee) was a purpose-built German vehicle that used components from both the PzKpfw III and IV. Used on all fronts, it was a successful weapon that remained in production until the war ended. It had a crew of five.

A battery of four Hummels stand ready for action on a Russian steppe in 1942. The closeness of the guns and the overall lack of concealment demonstrates that the Luftwaffe had air superiority at this time, otherwise the guns would have been much more dispersed and camouflaged.

Specification
Hummel
Type: self-propelled howitzer
Crew: 5
Weight: 24000 kg (52,911 lb)
Powerplant: one Maybach V-12 petrol engine developing 197.6 kW (265 hp)
Dimensions: length 7.17 m (23 ft 6.3 in); width 2.87 m (9 ft 5 in); height 2.81 m (9 ft 2.6 in)
Performance: maximum road speed 42 km/h (26.1 mph); road range 215 km (134 miles); fording 0.99 m (3 ft 3 in)
Armament: one 15-cm (5.9-in) howitzer and one 7.92-mm (0.13-in) machine-gun

German 'lash-ups'

In the wake of the lightning conquests of 1939-40, the German army's demands for self-propelled artillery soon outstripped factory production. With typical ingenuity, the Germans utilized the mass of tanks they had captured to produce a series of unusual improvisations.

In many ways the German army's heady successes of 1940 and 1941 were a long-term headache for the nation's war planners. They had not envisaged a European war breaking out before 1943 at the earliest, and both the German armed forces and defence industry were badly placed when war began in 1939. Hitler's political gambles at last produced a real war when he invaded Poland in September 1939, but the huge successes of the German armed forces distracted from the fact that they were ill-prepared for the type of Blitzkrieg employed by the German general staff. Many weapons were quite simply not up to the tasks asked of them, and there were never enough weapons either in the field or in reserve. Many of the major victories gained by Germany between 1939 and 1941 were produced as much by their enemies' unpreparedness and lack of cohesion as by the tactics and equipment of the German armed forces.

All this was to be revealed generally once the Germans began to lose the strategic initiative in 1942; but by then many of their faults were self-apparent. They quite simply lacked the equipment necessary to arm the ever-growing number of their divisions, and the shortages ranged from everyday items like telephone wire to heavy weapons. This was particularly true of artillery, for in 1940 most if not all of the German artillery was still towed, the bulk of it by horses. The first *Sturmgeschütze* (assault guns) made their debut during the French campaign, but for artillery support of the fast-moving Panzer divisions the German gunners had to rely on what was to be the first of a long string of equipments that can only be described as 'lash-ups'.

The first of these was a marriage of the very useful 15-cm (5.9-in) sIG 33 infantry support weapon with the chassis of the PzKpfw I light tank. The PzKpfw I had been designed for use only as a training tank, but it was still around as a front-line vehicle in 1940 although it was of very limited combat use. The Germans just replaced the turret of this vehicle with a sIG 33, complete with its wheels and carriage; a thin armour shield was placed around the gun and that was it; thus, they had something that could keep up with the tanks, and the first item of German self-propelled artillery was in the field.

The conversion of captured French Lorraine tracked vehicles to carry the German sIG 33 15-cm infantry howitzer was so successful that the result became a standard German vehicle known as the SdKfz 135/1. It had a crew of four, including the driver.

This initial attempt was not a great success, but served for some years. It was eventually replaced by more formal designs, most of which are described in these pages. But apart from the self-propelled German equipments discussed in this study there were many more that deserve mention. Few of them were 'formal' designs in the sense that they passed through the usual stringent design or testing stages. Instead they were knocked together by units in the field to provide themselves with local-defence or support weapons.

This policy was the result of two main factors. One has already been mentioned, namely the inability of Germany's defence industries to supply weapons and equipment in the quantities required; after 1941 the demands of the Eastern Front were such that it alone was allocated nearly all of the production quotas and still demanded more and more. The other fronts had to take what remained, or survive with what they could produce themselves, and this was particularly true along the Atlantic Wall once the Eastern Front campaigns were under way. Here the second factor arose: in such theatres the German forces had to make do with what they could get. The new production material went to the Eastern Front, and nothing could be spared for what were seen as purely defensive formations sitting along the coastal and internal defences of the occupied territories; it was here that the atmosphere was right for the German 'lash-up' to flourish.

Fortunately for them, the Germans had a rich stockpile with which to work. The victories of 1940 had left them with piles of weapons and equipment of all kinds, and these were duly passed to the occupation divisions in France and elsewhere. Items such as trucks were taken for the Eastern Front, but that still left large numbers of guns, small arms and tanks that were usually quite serviceable. Much of the captured French armour was of the 'tankette' type or consisted of heavier tanks that had either inadequate armament or one-man turrets that the Germans understandably did not want to use. But very often the hulls and chassis were good enough for further use and the 'lash-up' programme started.

As many of the German divisions in France and the occupied countries had only horse-drawn artillery, they understandably wanted to increase its mobility by the introduction of self-propelled mountings. There was no chance that they would ever see shiny new Wespe or Bison weapons, so these divisions initiated a programme that was to produce some of the oddest self-propelled artillery carriages ever seen. Virtually every French and other vehicle were used as the carriages for German artillery pieces. The units in France produced some of the oddest types, for they had to hand a diversity of vehicles ranging from ammunition carriers to tanks. The Chenilette Lorraine, originally a small artillery tractor or supply carrier, was the smallest type and this was used to mount howitzers as large as 15 cm (5.9 in). One of these conversions involved the 15-cm sFH 13 field howitzer dating from World War 1, and was considered so successful that some of them ended up in North Africa. This was unusual, for most of the lash-ups remained for strictly local deployment. Not all the conversions were for artillery use only. Many old captured tank and other chassis had anti-tank guns of one type or another, and many others were simply converted to turretless artillery tractors or ammunition carriers.

The SdKfz 138/1 Bison was a conversion of the Czech Skoda PzKpfw 38(t) to carry the 15 cm sIG 33 infantry howitzer for the close fire-support role. The Bison had the howitzer mounted forward; later PzKpfw 38(t) conversions had it mounted well to the rear with the engine forward.

Apart from the anti-tank guns, the German 10.5-cm (4.13-in) field howitzers were among the main candidates for extemporized self-propulsion. The French tanks such as the Hotchkiss H-39 were often converted to carry the 10.5-cm howitzer, and their turrets were carted off to be set into the concrete defences of the Atlantic Wall. Perhaps the oddest-looking of all these conversions was that carried out using the French B1 bis as a basis. This had the turret removed in the usual way and replaced by a fixed turret mounting a 10.5-cm leFH 18. This made the resultant product look both too high for comfort and awkward to an extreme. But for the German gunners it was such monsters or nothing as far as self-propelled artillery was concerned.

French armour was not the only source of conversions. Italy was another source, but there conversions were fewer as the Germans simply pressed into action any Italian weapons they could find. This usually meant the various Italian *semovente* that were not far removed from the German StuG III in armour and armament.

The lash-ups were many and various. Not all of them concerned artillery, for rocket projectors, flamethrowers and even command vehicles had their origins in local conversions. Mortar carriers were another product.

Apart from the Chenilette Lorraine conversion with the sFH 13, few of the lash-ups saw service outside their original localities. There they were used in their original command and organization structure alongside the other unconverted towed artillery batteries. When it came to the crunch in 1944 few of these lash-ups presented their opponents with any trouble. Most of them were virtual death-traps for their crews, but the even less welcome alternative was to face the Allies with horse-towed weapons. German industry was unable to help them in any way.

GERMANY

The Waffentrager

The **Waffentrager** (literally weapons carrier) was a novel concept for the Germans when it was first mooted during 1942. The idea was that the Waffentrager was to be not so much a form of self-propelled artillery but a means of carrying an artillery piece in a turret into action, where it would be removed from the tank, emplaced, used in action, and picked up again when no longer required. The exact tactical requirement for this arrangement is still uncertain, for in 1942 the Panzer divisions were still dictating mobile warfare to all opponents and the need for a static artillery piece seems remote.

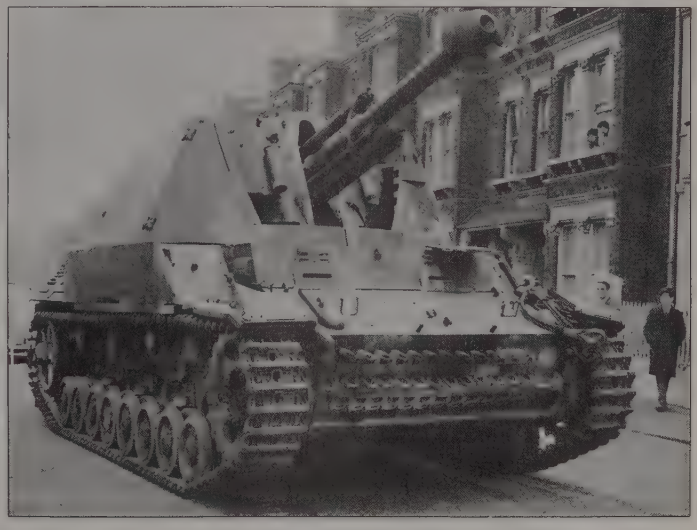
Be that as it may, a series of eight vehicles known generally as **Heuschrecke IVB** (locust) were produced during 1942. These vehicles were converted PzKpfw IV tanks with a gantry at the rear to lift off the turret mounting a 10.5-cm (4.13-in) light field howitzer. The turret could be emplaced on the ground for action or it could be towed behind the vehicle on wheels carried on the rear specifically for this purpose; this arrangement allowed the vehicle to be used as an ammunition carrier for the turret.

The eight vehicles produced were no doubt used in action, for one of them was captured and is now to be seen in the Imperial War Museum in London, but at the time no more were requested. But by 1944 things had changed somewhat. The German army was everywhere on the defensive and anything that could hold up the advancing Allies was investigated. The Waffentrager concept came within this category, and more designs were initiated. One was an interim design in which a normal field howitzer, a 10.5-cm leFH 18/40, was carried in an armoured superstructure on top of a modified Geschützwagen III/IV (normally used for the Hummel). The howitzer could be fired from the vehicle, but it was also designed to be removed from the carrier using a block and tackle and mounted on the ground as a normal field piece once the wheels and carriage trails had been fitted. This design did not get far for it was overtaken by a series of design projects that were in turn overtaken by the end of the war.

These late-1944 and early-1945 Waffenträger all adopted the removable turret concept used in the 1942 Heuschrecke IVB. They had a variety of chassis, including both the modified PzKpfw IV and Geschützwagen III/IV. The artillery pieces involved ranged from 10.5-cm to 15-cm (5.9-in) howitzers. One that got as far as model form was to have carried either the 10.5-cm or 15-cm howitzer on a cruciform carriage that would have been used with the '43' series of weapons had they ever advanced further than the prototype stage. These howitzers were mounted in an open-backed turret, and could be fired from the carrier or from a ground mounting. They could also be towed behind the carrier on their field carriages. It was all rather complicated and overengineered as it involved the use of ramps and winches, and the concept was typical of many that never got to the hardware stage. But a few such equipments were built only to be overtaken by the end of the war, being broken up or scrapped in the post-war years.

Specification
Heuschrecke IVB
Type: self-propelled howitzer carrier
Crew: 5
Weight: 17000 kg (37,479 lb)
Powerplant: one Maybach petrol engine developing 140.2 kW (188 hp)
Dimensions: length 5.90 m (19 ft 4.3 in); width 2.87 m (9 ft 5 in); height 2.25 m (7 ft 4.6 in)
Performance: maximum road speed 45 km/h (28 mph); road range 250 km (155 miles)
Armament: one 10.5-cm (4.13-in) howitzer

The Heuschrecke was one of a number of experimental German vehicles that were meant to carry an artillery piece to a firing site and then lower the piece to the ground for firing. The Heuschrecke was the only one of many similar designs to be produced in any numbers.



This Heuschrecke prototype was one in which a 105-mm field howitzer was carried on a chassis produced from PzKpfw III and IV components in order for it to be lowered to the ground when at the firing position. The howitzer could be fired from the vehicle if required.

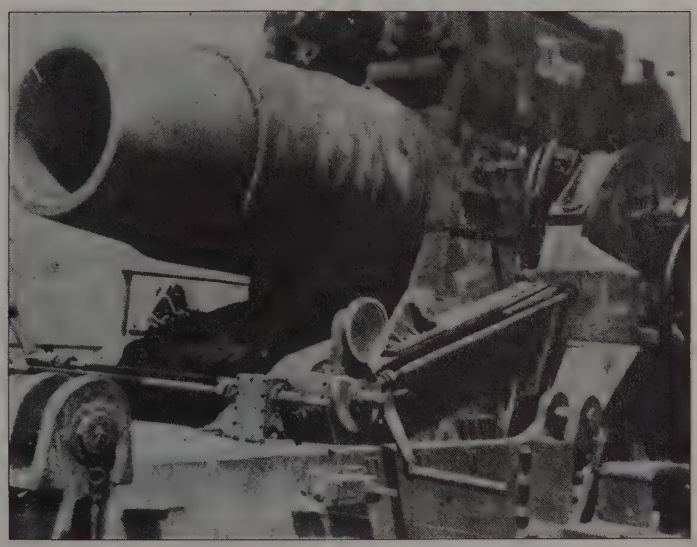
GERMANY

Karl series

The weapons known as **Karl** were originally devised as anti-concrete weapons for the demolition of the Maginot Line forts and other such fortified locations. They were produced during the 1930s following a great deal of mathematical and other theoretical studies carried out during the 1920s. Work on the actual hardware began during 1937, and the first equipment was ready by 1939.

The Karl series must be regarded as being the largest self-propelled artillery weapons ever produced. There were two versions. One was the **60-cm Mörser Gerät 040** which mounted a 60-cm (23.62-in) barrel and the other the **54-cm Mörser Gerät 041** which mounted a 54-cm (21.26-in) barrel. Both weapons fired special concrete-piercing projectiles. The range of the Gerät 040 was 4500 m (4,921 yards) and that of the Gerät 041 6240 m (6,824 yards). Both could penetrate between 2.5 and 3.5 m (8.2 and 11.5 ft) of concrete before detonating to produce maximum effect. These projectiles were massive items. The 60-cm shell weighed no less than 2170 kg (4,784 lb), although a lighter version was also used. The 54-cm shell weighed 1250 kg (2,756 lb).

Both Karl weapons were massive, ponderous brutes. Although technically self-propelled, their mobility was limited by their sheer weight and bulk and the tracked carriages were meant for only the most local of moves. For long-distance travel they were carried slung between special railway trucks. Shorter moves were made by removing the barrel from the carriage and placing both the barrel and the carriage on separate special trailers towed by heavy tractors. Assembly



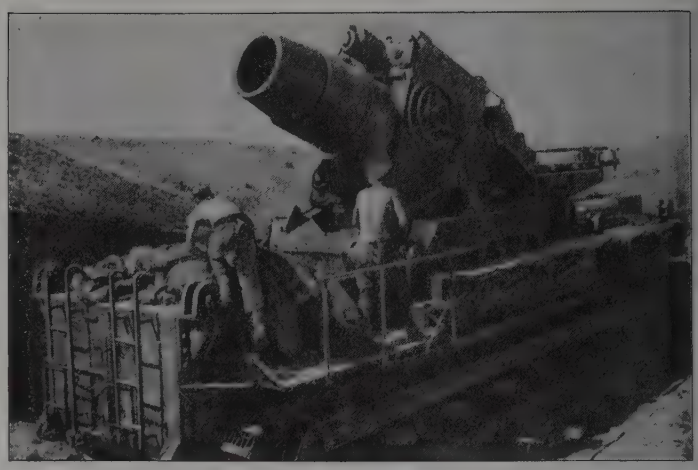
The Karl howitzers were intended to smash the Maginot Line forts, but were instead used against the Sevastopol defences and later against Warsaw in 1944. They fired special anti-concrete projectiles that exploded only when they had penetrated their targets.

and break-down was carried out using special mobile gantries. The whole process was difficult to an extreme, but the Karl weapons were not intended for mobile warfare. They were produced to reduce fortresses and that meant a long, planned approach to the firing site, a slow rate of fire (the best was one round every 10 minutes) and a steady withdrawal once the fortress had been reduced.

The Karls were too late for the Maginot Line, which fell along with the rest of France in 1940. Their first real engagement was the siege of Sevastopol in exactly their designed role. Following the successful end of that siege more Karls were used during the Warsaw uprising when they were used to demolish the centre of Warsaw and crush the Polish underground fighters.

By then it was 1944. Most of the early 60-cm barrels had then been replaced by 54-cm barrels, but Warsaw was their last period in action. The increasing mobile warfare of the last year of the war gave the Karls no chance to demonstrate their destructive powers, and most were destroyed by their crews in the last stages of the war. Only a few of the special PzKpfw IV ammunition carriers produced to carry projectiles for the Karls survived for Allied intelligence staffs to examine. It is possible that one example of the Karl may survive as a museum piece in the Soviet Union, but that is all.

Specification
Gerät 041
Type: self-propelled siege howitzer
Crew: not recorded
Weight: 124000 kg (273,373 lb)
Powerplant: one V-12 petrol engine developing 894.8 kW (1,200 hp)
Dimensions: length of barrel 6.24 m (20 ft 5.7 in); length of carriage 11.15 m (36 ft 7 in); track 2.65 m (8 ft 8.3 in)
Performance: not recorded
Armament: one 54-cm (21.26-in) howitzer/mortar



The massive 60-cm and 54-cm Karl howitzers were really fortification-smashing equipments, and they had only limited tactical mobility. They had to be carried to the firing positions by special trailers in pieces and assembled on site.

GERMANY

Brummbär

Despite their overall success, the StuG III assault guns were considered by 1943 as being too lightly armoured for the assault role, and a new heavy assault vehicle was required. The existing 15-cm (5.9-in) sIG 33 self-propelled equipments lacked the armour protection required for the close-support role and so, with the PzKpfw IV tank gradually being replaced by the Panther and Tiger tanks, there was the chance to produce a purpose-built vehicle using the later versions of the PzKpfw IV as a basis.

The first examples of this new vehicle appeared during 1943 under the designation *Sturmpanzer IV Brummbär* (grizzly bear). The Brummbär used a box structure formed from sloping armour plates set over the front of a turretless PzKpfw IV, and mounted a specially developed howitzer in a ball mounting on the front plate. This howitzer was known as the Sturmhaubitze 43 and was a shortened version, only 12 calibres long, of the 15-cm sIG 33. Armour was provided all round (the frontal armour being 100 mm/2.54 in thick), so the crew of five men were well protected. Later stand-off side armour was added, and most vehicles acquired a coating of Zimmerit plaster paste to prevent magnetic charges being stuck on to the hull by close-in tank killer squads. A machine-gun was mounted on the hull front plate on late production models, earlier versions having lacked this self-defence weapon.

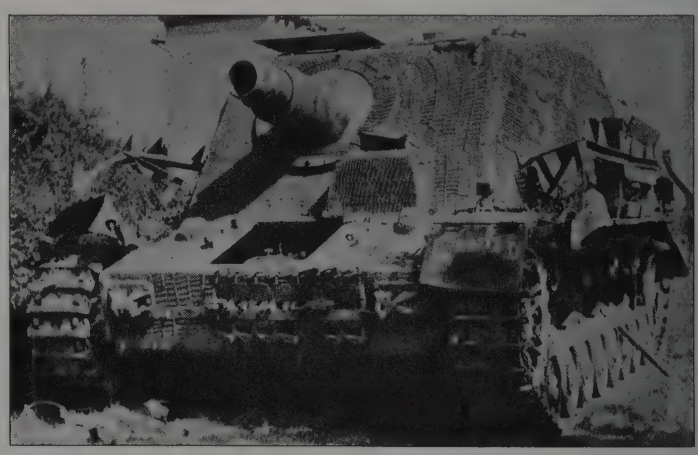
The roomy fighting compartment of the Brummbär could accommodate up to 38 rounds of 15-cm ammunition. The commander sat to the rear of the howitzer using a roof-mounted periscope to select targets. Two men served the gun and handled the ammunition, while another acted as the gun layer. The driver normally remained in his seat at the left front. Most targets were engaged with direct fire, but provision was made for indirect fire.

About 313 Brummbär vehicles were produced before the war ended, and most appear to have been used in direct support of Panzergrenadier and infantry units. The vehicles moved forward with the first waves of attacking troops and provided fire to reduce strongpoints and smash bunkers. Infantry had to remain close to prevent enemy tank-killer squads from coming too close to the Brummbär vehicles, which were always vulnerable to close-range anti-tank weapons, especially as some of their side armour was as thin as 30 mm (1.18 in). Brummbär vehicles were generally used in ones and twos split up along an area of attack. As defensive weapons they were of less use, for the short howitzer had only a limited performance against armour as its prime mission was the delivery of blast effect HE projectiles. One factor that restricted the Brummbär's overall mobility was its weight, which gave the vehicle a rather poor ground-pressure 'footprint': it was nippy enough on roads, but across country it could get bogged down in soft ground.

The Brummbär was a well-liked vehicle that often provided exactly the degree of fire support required by infantry formations. On the debit side it was heavy, rather ponderous and the early examples lacked close-in protection. But they were well protected against most weapons and they carried a powerful howitzer.

Specification
Brummbär
Type: self-propelled heavy assault howitzer
Crew: 5
Weight: 28200 kg (62,170 lb)
Powerplant: one Maybach V-12 petrol engine developing 197.6 kW (265 hp)
Dimensions: length 5.93 m (19 ft 5.5 in); width 2.88 m (9 ft 5.4 in); height 2.52 m (8 ft 3.2 in)
Performance: maximum road speed 40 km/h (24.85 km/h); maximum road range 210 km (130 miles); fording 0.99 m (3 ft 3 in)
Armament: one 15-cm (5.9-in) howitzer and one or two 7.92-mm (0.31-in) machine-guns

Most German self-propelled equipments carried only light armour, so when a call was made for a special close-support assault gun the result was the heavily-armoured Brummbär. The Brummbär was often used for street fighting, as this captured example shows.



The Brummbär was normally used when infantry tank-killer squads were likely to be encountered. It was therefore liberally covered with a plaster-like substance known as 'Zimmerit' that prevented magnetic charges from sticking to the hull.

GERMANY

Sturmtiger

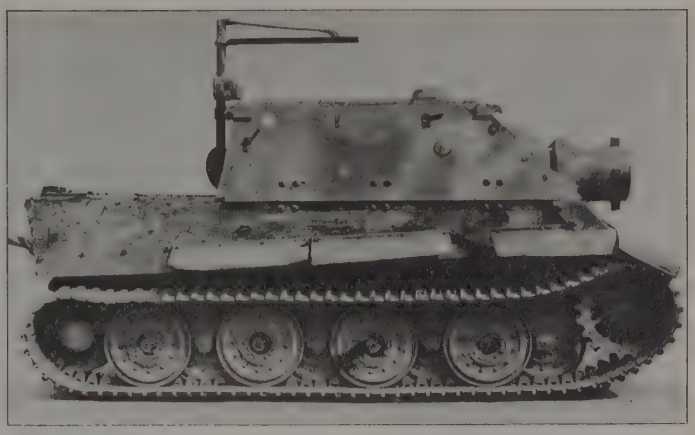
Stalingrad taught the German army many lessons, not least of which was that the Germans were ill-equipped for the art of close-quarter street fighting. In typical fashion they decided to meet any future urban warfare requirements by a form of overkill by using a super-heavy weapon that would do away with the need for house-to-house fighting by simply blowing away any defended houses or structures. This they decided to do with a land version of a naval weapon, the depth charge.

In 1943 the Germans produced a version of the Tiger tank known by several names including **38-cm Sturmmörser, Sturmpanzer VI** and **Sturmtiger**. Whatever the designation, the weapon was a Tiger tank with the turret replaced by a large box-shaped superstructure with a short barrel poking through the front sloped plate. This barrel was not a gun but a 38-cm (14.96-in) Raketenwerfer 61 rocket projector of an unusual type, for it fired a rocket-propelled depth charge that weighed no less than 345 kg (761 lb). As this projectile was based upon the design of a naval depth charge nearly all the weight was high explosive; the effect of this upon even the stoutest structure can well be imagined. The rockets had a maximum range of 5650 m(6,180 yards), and the projector barrel was so arranged that the rocket efflux gases were diverted forward to vent from venturi around the muzzle ring. The Sturmtiger was exceptionally well armoured, with 150 mm (5.9 in) at its front and between 80 and 85 mm (3.15 and 3.35 in) at the side.

The Sturmtiger had a crew of seven including the commander, a fire observer and the driver. The other four men served the rocket projector. Because of their massive size, only 12 projectiles could be carried inside the superstructure, with the possibility of one more inside the projector. Loading the rockets into the vehicle was helped by a small crane jib mounted on the superstructure rear, and a small hatch nearby allowed access to the interior. Once inside overhead rails assisted in the movement of the rockets to and from their racks along each side, and loading into the projector was carried out using a loading tray.

Although the Sturmtiger prototype was ready by late 1943, it was not until August 1944 that production of this massive vehicle got under way. Only about 10 were ever produced, and these were used in ones and twos on most fronts but in situations where their powerful armament was of little advantage. Consequently most were soon either knocked out in action or simply abandoned by their crews once their fuel allocation had been used.

Used as they were in isolation and in such areas as the North Italian campaign, the hulks fascinated the Allies who encountered them and many detailed intelligence reports were written on them. Most realized that the Sturmtiger was a highly specialized weapon that was simply pushed into the field during the latter stages of the war in the German effort to get any weapon into action. If the Sturmtigers had been used as intended for street fighting, they would have been formidable weapons. Instead, by the time they were ready the time of concentrated urban warfare had passed.



Above: This side shot of a Sturmtiger shows the large armoured superstructure, mounting the 38-cm (14.96-in) rocket projector with the roof-mounted crane needed to load the projectiles into the interior through a hatch at the rear.

Below: Largest of all the German close-support weapons was the Sturmtiger, carrying a 38-cm rocket projector that fired a form of naval depth charge to demolish buildings. This example has been captured by American troops.

Specification
Sturmtiger
Type: assault gun
Crew: 7
Weight: 65000 kg (143,300 lb)
Powerplant: one Maybach V-12 petrol engine developing 484.7 kW (650 hp)
Dimensions: length 6.28 m (20 ft 7.25 in); width 3.57 m (11 ft 8.6 in); height 2.85 m (9 ft 4.2 in)
Performance: maximum road speed 40 km/h (24.86 mph); road range 120 km (75 miles); fording 1.22 m (4 ft)
Armament: one 38-cm (14.96-in) rocket projector and one 7.92-mm (0.31-in) machine-gun

GERMANY

Sturmgeschütz III

Following from its experiences in World War I, the German army saw the need for an armoured mobile gun that could follow infantry attacks and provide fire support and the firepower to knock out strongpoints and bunkers. During the late 1930s such a gun was developed using the chassis, suspension and running gear of the PzKpfw III tank. This armoured gun was known as the **Sturmgeschütz III** though its formal designation was **Gepanzerte Selbstfahrlafette für Sturmgeschütz 7.5-cm Kanone SdKfz 142**, (assault gun model 3) and it had the usual upper hull and turret of the tank replaced by a thick carapace of armour with a short 75-mm (2.95-in) gun mounted in the front. This weapon was first issued for service in 1940 (**StuG III Ausf A**) and was soon followed by a whole series of vehicles that gradually incorporated overall and detail improvements, to the extent that when the war ended in 1945 many were still in service on all fronts. The 1941 models were the **StuG III Ausf B, C** and **D**, while the slightly improved **StuG III Ausf E** appeared in 1942.

The main change to the Sturmgeschütz III (or StuG III) series was a gradual programme of upgunning. The original short 75-mm gun was an L/24 weapon (i.e. the length of the barrel was 24 times the calibre) and had limitations against many targets except at short ranges. Thus it was replaced by longer guns with improved performance, first an L/43 (**StuG III Ausf F**) and then an L/48 gun (**StuG III Ausf G**). The latter gun also provided the StuG III series with an anti-tank capability, and this was in a way to the detriment of the original assault-support concept, for it was far easier to produce a StuG than it was a tank, so many StuG IIIs with L/48 guns were diverted to the Panzer divisions in place of battle tanks. Used as a tank-killer the StuG III had its moments, but it lacked traverse and adequate protection for the task. It had to be retained as such, however, for German industry simply could not supply enough tanks for the Panzer divisions.

As an assault gun the StuG III series was far more successful. Eventually the type was upgunned to the stage late in the war when many StuG IIIs were armed with the powerful 10.5-cm (4.13-in) Sturmhaubitze, a special assault howitzer produced for the **StuG III für 10.5-cm StuH 42**. The first of these was completed in 1943, but manufacture of this variant was initially slow. Instead the version with the 75-mm L/48 gun was rushed off the production lines for the Panzer divisions.

The StuG III had a crew of four and extra machine-guns were often carried behind a shield on the roof. The protective mantlet for the main gun underwent many changes before it ended up as a *Saukopf* (literally 'pig's head') mantlet which proved very good protection. More protection against short-range hollow-charge warheads was provided with the addition of *Schützen* (literally 'skirts') along both sides. These were simply sheets of stand-off armour to detonate the warheads before they hit the vehicle armour, and were used on many German tanks after 1943.

As a close-range assault support weapon the StuG III series was an excellent vehicle/weapon combination. It was also relatively cheap and easy to produce, and in war-time Germany that mattered a lot. Therefore the series was built in some numbers and numerically it was one of the most important German armoured vehicles.

Specification
StuG III Ausf E
Type: assault gun
Crew: 4
Weight: 23900 kg (52,690 lb)
Powerplant: one Maybach V-12 petrol engine developing 197.6 kW (265 hp)
Dimensions: length 6.77 m (22 ft 2.5 in); width 2.95 m (9 ft 8 in); height 2.16 m (7 ft 1 in)
Performance: maximum speed 40 km/h (24.85 mph); road range 165 km (102 miles); fording 0.8 m (2 ft 7.5 in)
Armament: one 75-mm (2.95-in) gun and two 7.92-mm (0.31-in) machine-guns

The Sturmgeschütz in Action

Designed to a 1936 Wehrmacht requirement for an armoured close support vehicle, the Sturmgeschütz III was introduced in 1940 and fought in all theatres until 1945, both in an artillery and tank destroyer role.

The German army Sturmgeschütz III was originally to be organized into *Sturmgeschützabteilungen* (assault gun battalions), each with a small headquarters battery and three batteries, each of six or eight vehicles. These *Abteilungen* were usually assigned to Panzergrenadier divisions, where they frequently assumed the responsibilities of the standard anti-tank *Abteilung*, a task for which their 7.5-cm (2.95-in) Sturmkanonen 40 were well suited, for this StuK 40 was a development of the towed 7.5-cm Panzerabwehrkanone 40, or Pak 40. This armament was equally suitable for firing conventional HE ammunition in direct support of units other than the Panzer formations, but all too often the StuG crews found themselves being rushed into action not in support of any particular type of unit but as part and parcel of Panzer division operations.

This StuG III shows the overall low silhouette and the stand-off side armour plates. Although meant to be used as close-support artillery, these vehicles were often used as tank-killers and were often deployed instead of tanks in some Panzer formations, despite their lack of gun traverse.

A T-34, not yet whitewashed against the snow, lies burning as the commander of the StuG peers through his binoculars seeking another target. German infantry sensibly keep a low profile but are alert to the ever-present danger of Soviet tank killer squads.

The main reason for this was the inability of German industry to produce the numbers of tanks required by the ever-expanding Panzer and other divisions, especially after 1941. The German general staff planners had always hoped for a short, sharp war, but with the invasion of the Soviet Union in 1941 (Operation 'Barbarossa') the course of the war was clearly set for a long time. The invasion of the Soviet Union stretched the manpower and materiel levels of the German armed forces to the limit, and calls for ever increasing quantities of equipment became frantic.

The German army tank arm got considerable priority over other sectors of the army, but as the Russian terrain and the Red Army soaked up more and more of the German tank strength, replacements began to get scarce. The main reason for this was that even as late as 1941 the German defence industries were not yet on a war footing. Shift working was almost unknown, and even the tank factories continued to work at a pace that realized only a small percentage of their true production potential. During 1941 a drastic shake-up of the war industrial organization began, but even with the drafting of forced labour, the introduction of round-the-clock working and a drastic revision of production priorities, tank production could still not match demand. Tanks are not easy things to produce quickly, and although the quality of the German product was usually superb the front-line soldiers always wanted quantity as well as quality.

It was a time for the usual improvisation. In the short term the Panzer formations pressed captured Soviet tanks into their own use. The advances of 1941 and early 1942 meant that huge stockpiles of Soviet equipment fell into German hands, much of it serviceable, and the Germans simply painted out the Soviet markings and painted on their own. This booty included numbers of T-34 tanks, and for a while some German tank formations were completely equipped with T-34s. On the battlefield this was a hazardous policy and many recognition ploys were attempted to define friend from foe, but there was always a risk of incorrect identification and all too often 'German' T-34s became casualties of their own weapons. Despite this, the practice of using captured T-34s persisted right up to the end of the war.

The use of captured equipment could at best be a only a stopgap. In their search for a rapid expedient the German planners hit upon the idea of the StuG, deciding that the StuG III would become an integral part of the Panzer formations. The idea looked good; despite the costs and time involved, it was still relatively easy and inexpensive to produce a StuG in comparison with a tank, for the latter took longer and involved more industrial operations; and weight-for-weight the StuG could carry heavier armament and more armour protection, while it also had a lower tactical silhouette than a tank. Thus the StuG was given a high production priority and the Panzer divisions took what they were given.

So acute was Germany's shortage of tanks that the StuG was often employed in close combat. Seen here street-fighting on the Eastern Front, the StuG is severely hampered by its lack of gun traverse – a turretless tank was cheaper to produce but sometimes unfortunately expensive for the crewmen.

By the middle of the war, hand-held anti-tank weapons were becoming an increasing threat to armoured vehicles. One German solution was Schützen, *literally skirts of thin armour plate attached to the vehicle side which prematurely detonated hollow charge projectiles, dramatically reducing their penetration.*

Sturmgeschütz III

The Sturmgeschütz Sdkfz 142 was based on the chassis of the PzKpfw III with the gun mounted in the hull. The driver's station was unaltered from that of the tank, but behind him now was a large but cramped fighting compartment. Initially fitted with a short 75-mm (2.95-in) gun, the F model shown here was introduced in 1942 and carried a long 75-mm weapon, significantly improving anti-tank capability. The G model with its 75-m L/48, heavier armour and smoke dischargers, was designed more as a tank destroyer than a self-propelled gun. By contrast, as early as 1941 variants were in production mounting a 105-mm (4.1-in) howitzer. Armoured skirts were fitted as standard from 1943.

PETER SARSON & TONY BRYAN.

Two StuG III move forward in the Soviet Union in 1944. They are armed with long 75-mm anti-tank guns and are carrying extra track links for added protection. More protection comes from the stand-off side plates known as 'Schützen' (skirts) carried to defeat close-range hollow charge anti-tank warheads.

A StuG is seen on the Eastern Front against a distant target. In order to better observe the fire, one of the gun crew is using the hull roof for observation. Note that the vehicle is equipped with the wide 'Ostkette' tracks for use over snow and soft ground to improve traction.

The German StuG III, seen here armed with a long 75-mm gun, was a close fire-support version of the PzKpfw III tank and was produced in considerable numbers, sometimes taking the place of battle tanks in Panzer formations. It was a powerful support weapon that usually fired over open sights.

The trouble was that although the introduction of the StuGs made the figures look better, they were no real substitute for the tank. It lacked the full 360° gun traverse that was so essential for armoured warfare, and in an armoured action it took too much time to move into a firing position, whereupon it lacked the ability to switch from one target to another with speed and ease. If it was in the right position at the correct time the StuG could knock out an enemy tank easily enough, but to get into that place in a hurry often took too long. The only long-term result of this infusion of assault guns into the Panzer divisions was that they lost a great deal of their earlier punch and fighting edge while offering the Nazi hierarchy a false impression of combat capability. The new 'mixed' tank/StuG formations could not have the impact of 'all tank' formations, and the combat potential of the Germany army suffered as a result.

With the Panzer divisions the StuGs were often forced to adopt their original role of close fire support. An attack would commence with long-range (sometimes indirect) fire, laid down by the StuG IIIs' 7.5-cm guns on the positions to be attacked. This opening fire was usually carried out in concert with the formation's towed or self-propelled artillery batteries. As the attack moved forward the StuGs followed in the main body of armour, using their guns to reduce strongpoints such as bunkers or defended houses and to lay down covering fire as the tanks and their motorized infantry moved up to their objectives. If enemy tanks appeared the StuGs could adopt a tank-killer role, though only if the target was to the front. If an enemy tank appeared on a flank the StuGs were often sitting targets, for they infrequently had time to turn the whole vehicle to bring the gun to bear before the enemy could open fire.

Moving into action in a StuG III cannot have been a very pleasant experience. Like those of most armoured vehicles, the interior of the StuG III was cramped and uncomfortable. Much of the interior of the main fighting compartment was taken up by the breech of the 7.5-cm gun. Ammunition racks lined the lower portion of the white-painted walls, while radios and other black boxes occupied what was left of the bulkhead space. The driver sat in his own position to the left front, most of the time peering through his armoured vision slits and trying to make out where he was going. Generally the driver was guided by orders from the commander, who sat under his cupola behind the driver. When possible the commander kept his hatch open and raised his head for better vision, but in action and closed down he could often see little more than the driver. The loader sometimes aimed and fired the 7.92-mm (0.31-in) machine-gun by controls from within the vehicle. This machine-gun was an MG34 or MG42, and when occasion allowed this was usually used from behind a shield on the roof. To the right of the commander sat the loader, who had his own overhead hatch that was seldom used in action; he also had a small hatch in the rear wall through which spent cases were despatched to avoid cluttering up the floor of the interior. Just in front of the commander and almost in his lap sat the gun layer with his gun controls. His outlook was limited to what he could see through his sighting devices: a small panoramic telescope was set in the roof for laying indirect fire and a telescope was placed in front for direct aiming.

Given the noise of the engine, the constant jolting from the suspension, and the fumes and smells of the gun and fuel, life for the StuG crews must have been very unpleasant. But they could take heart from the fact that they at least had more armour around them than most of their tankborne colleagues, and that many tank interiors were even more unpleasant and cramped than that of the StuG III.

When the war ended the StuGs were used mainly by the Panzer formations. Some StuGs had been produced specifically for use by infantry units and fitted with 10.5-cm (4.1-in) howitzers in place of the guns. But few of these were built in comparison with the StuG IIIs with 7.5-cm guns. By the time the war ended StuG III carapaces were even being fitted to surplus PzKpfw IV hulls. By 1944 the PzKpfw IV was considered to be well past its prime as a battle tank, so the production line was converted to produce yet more assault guns to join those still trying desperately to stem the advances of the Allied and Red armies. By then the Allied tide had grown to such an extent that not even heavier self-propelled weapons could stop it, but the StuG crews and their Panzer colleagues did their best right up to the end.

JAPAN

Type 4 HO-RO

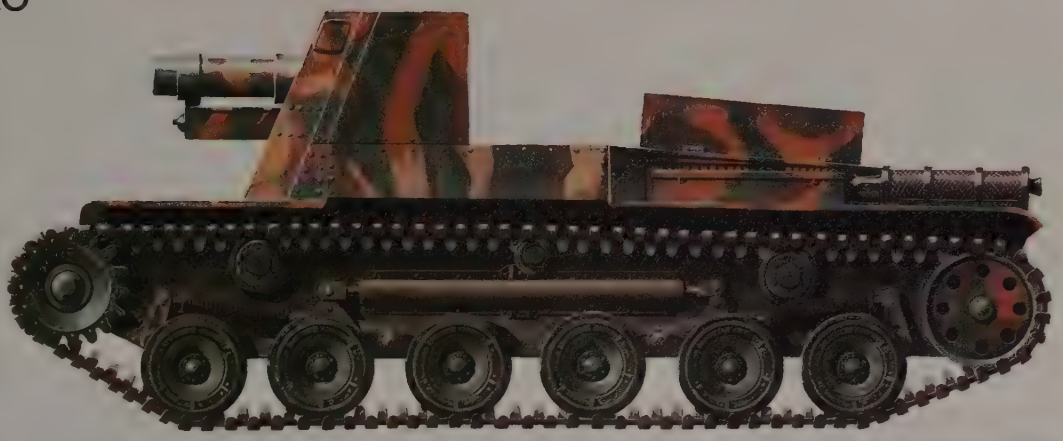
The Japanese were behind in armoured warfare development throughout all their World War II campaigns. Their early military excursions into China and Manchuria misled them into disregarding the need for heavy armoured vehicles, and instead they concentrated on what were regarded elsewhere as light tanks and tankettes. This approach was supported by the state of Japanese industry, which was still in a relatively early state of industrial development and lacked large-scale production capability. Thus it was that the Japanese army fell way behind in the development of self-propelled artillery, and ultimately only a small number of equipments were produced.

One of these was the **Type 4 HO-RO**, a self-propelled howitzer that allied the Type 38 150-mm (5.9-in) howitzer with the Type 97 medium tank. The conversion to the self-propelled role was a straightforward design task in which the howitzer was mounted in a shield which provided forward and side armour protection while leaving the top and rear open; the side armour, it is worth noting, did not extend even to the rear of the fighting compartment. The howitzer dated from 1905 and was derived from a Krupp design. It fired a 35.9-kg (79.15-lb) projectile to a range of 5900 m (6,452 yards), but most of these weapons were so old and worn that they had been withdrawn from general use after about 1942. They had a slow rate of fire as a result of the type of breech mechanism employed, but they were apparently thought good enough for the self-propelled role.

The chassis used for the Type 4 was the Type 97 CHI-HA, a medium tank by Japanese standards and dating from 1937. It was a mobile enough vehicle, but showed a relative lack of development in its thin armour, which was only about 25 mm (1 in) thick on the gun shield frontal armour, and in its overall riveted construction. The use of rivets in tank construction had elsewhere long disappeared, but the Japanese had no option but to retain the method as they lacked any other form of construction capability.

They also lacked the ability to produce the Type 4 HO-RO in anything but small numbers. Even those were virtually hand-built, with few pretensions to mass production. Even then the Japanese did not concentrate on the Type 4 HO-RO alone, for they also produced a version known as the **Type 2** mounting a 75-mm (2.95-in) gun and designed to double as a self-propelled artillery platform and a tank-killer. Again only small numbers were produced.

The Type 4 HO-RO vehicles appear not to have been organized into anything larger than four-howitzer batteries. No records survive of larger formations, and most accounts refer to these vehicles being captured or knocked out in ones or twos. Very often they were assigned for island defence in the amphibious campaign leading to the Japanese mainland, and only a few were captured intact.



Above: The Type 97 mounted a short Type 38 howitzer with limited range, but the Japanese were never able to produce the numbers required and they were mainly used in ones and twos as local fire-support weapons.

The Type 97 had its 150-mm howitzer mounted in place of the turret normally carried. The howitzer was meant to be used as a form of mobile field artillery but was normally used as close support artillery.

Specification
Type 4 HO-RO
Type: self-propelled howitzer
Crew: 4 or 5
Weight: not recorded, but about 13600 kg (29,982 lb)
Powerplant: one V-12 diesel developing 126.8 kW (170 hp)
Dimensions: length 5.537 m (18 ft 2 in); width 2.286 m (7 ft 6 in); height to top of shield 1.549 m (5 ft 1 in)
Performance: maximum road speed 38 km/h (23.6 mph)
Armament: one 150-mm (5.9-in) howitzer

ITALY

Semovente da 149/40

The Italian army was not far behind the Germans in realising the need for assault guns, and developed a string of vehicles that outwardly resembled the German StuG III. These Italian assault guns were produced in appreciable numbers, for they were better armoured and in relative terms quicker to produce than contemporary Italian tanks. But by the time significant numbers had been issued Italy was effectively out of the war, and most of these Italian assault guns fell into German hands.

The majority of Italian self-propelled weapons, known as *semovente*, mounted 75-mm (2.95-in) or 105-mm (4.13-in) guns and howitzers of varying lengths, but since these were direct-fire mounts the Italian artillery arm still required self-propelled artillery weapons to support the armoured formations. Accordingly Ansaldo diverted some of its precious development facilities to design a powerful artillery weapon that could be carried on a trucked chassis. In the end Ansaldo plumped for an existing weapon, the long Canone da 149/40 modello 35, and decided to place it on a much-modified Carro Armato M.15/42 tank chassis. The selection of these two items of equipment was made in order to produce as good a carriage/weapon combination as possible, but the snag was that the Italian army was already

The long, lean lines of the Italian 149/40 can be seen at the Aberdeen Proving Grounds in Maryland, USA, still looking very serviceable as a modern artillery weapon despite the lack of crew protection and stowage on the vehicle for ammunition and other items.

crying our for large numbers of both the gun and tank. Italian industry quite simply could not keep up with the existing demands and so the new self-propelled weapon, known as the **Semovente da 149/40**, got off to a shaky start.

The Semovente da 149/40 was a completely unprotected weapon as the long gun barrel was placed on an open mounting carried on the turretless tank chassis. The gun crew stood in the open to serve the gun, which had its trunnions mounted right to the rear to absorb some of the recoil forces produced on firing. It was late 1942 before the first prototype was ready for prolonged firing trials, but even before these were over unsuccessful attempts were being made to start production. Before the lines could start rolling the Italians surrendered to the Allies, and the Germans took over what was left of the Italian economy. Thus the Semovente da 149/40 prototype remained the sole example of what seemed to be a promising design. The gun of the Semovente da 149/40 was certainly a useful weapon: it could fire a 46-kg (101.4-lb) projectile to a range of 23700 m (25,919 yards), at which distance the lack of protection for the gun crew would have been of relatively little importance.

The prototype survived the war, and can now be seen at the Aberdeen Proving Grounds in the USA. It still looks a thoroughly modern piece of equipment that would not be too out of place in many modern gun parks.

Specification
Semovente da 149/40
Type: self-propelled gun
Crew: (on gun) 2
Weight: 24000 kg (52,911 lb)
Powerplant: one SPA petrol engine developing 186.4 kW (250 hp)
Dimensions: length 6.60 m (21 ft 7.8 in); width 3.00 m (9 ft 10 in); height 2.00 m (6 ft 6.7 in)
Performance: maximum road speed 35 km/h (21.75 mph)
Armament: one 149-mm (5.87-in) gun

USSR

SU-76

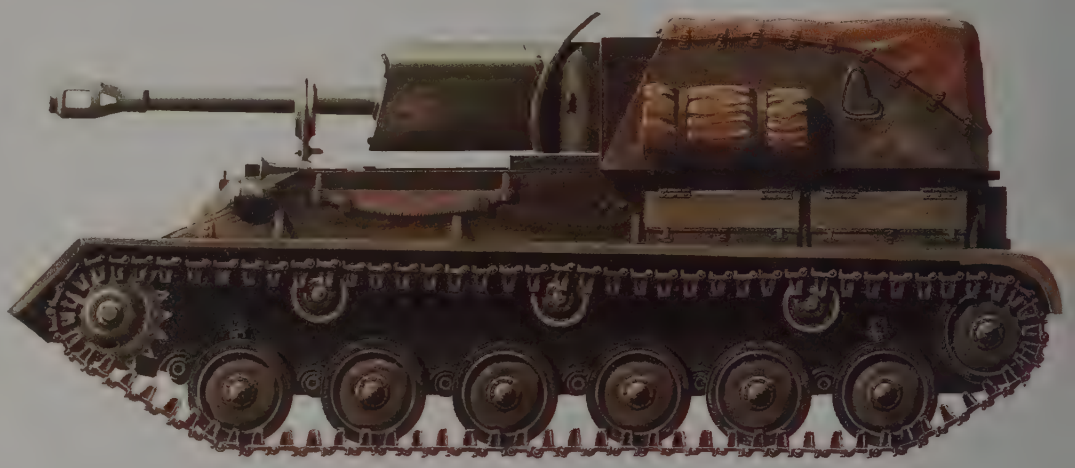
During the desperate days of 1941 the Red Army lost so much materiel that Soviet planners were forced to list mass production as their top priority, and in order to cut down the numbers of equipments being produced only a few types were selected for future use. One of these types was the superlative ZIS-3 76.2-mm (3-in) gun, which was not only an excellent field piece but at that period also a good anti-tank gun. Thus when it was decided to adopt the ZIS-3 in quantity the Red Army had a very good weapon for the future, especially when the chance arose to make the weapon a self-propelled one

The events of 1941 had shown the Red Army that its light tanks were virtually useless, and the type was scheduled for withdrawal from production and service. A production line was in existence for the T-70 light tank, however, and it was decided to convert the T-70 to take the ZIS-76 gun as a highly mobile anti-tank weapon. Thus was born the **SU-76** (SU for *Samokhodnaya Ustanovka*, or self-propelled mounting). The conversion to take the 76.2-mm gun and 62 rounds of ammunition was a simple one, but the T-70 chassis had to be widened somewhat and an extra road wheel was added to take the extra weight. The first examples had the gun mounted centrally, but later models had the gun offset to the left. Maximum armour thickness was 25 mm (0.98 in).

It was late 1942 before the first SU-76s were produced, and it was mid-1943 before they were in Red Army service in any appreciable numbers. By that time the ZIS-3 gun had lost much of its edge against the ever-thickening German tank armour, and thus the Su-76 was gradually phased over to the direct fire-support of Red Army infantry formations. Some anti-tank capability was retained when new anti-armour ammunition was introduced, but by the end of the war the SU-76 was being phased out in favour of vehicles with larger-calibre guns. Many SU-76s were pressed into other roles by 1945. The usual process was to remove the gun and then use the vehicle as a supply and ammunition carrier, as an artillery tractor and as a light armoured recovery vehicle. Some were fitted with anti-aircraft cannon.

After 1945 there were still many SU-76s to hand, and the Soviets handed them on to many friendly nations including China and North Korea, with whom the type saw another bout of action during the Korean War that started in 1950. More went to some of the Warsaw Pact armed forces. It is doubtful that the new recipients welcomed the SU-76, for it was very much a wartime expedient vehicle with no crew comforts whatsoever. Apart from a few examples that had an armoured roof, the crew compartment of the SU 76 was open to the elements and the driver had to sit next to the twin engines with no intervening bulkhead. The Red Army knew the SU-76 as the *Sukami* (bitch).

Thus the SU-76 started life as a mobile anti-tank weapon and ended up as an artillery support weapon. It was no doubt a very useful weapon in the latter role, but essentially it was a hasty expedient rushed into production at a time of desperate need. Surprisingly, the type may still be encountered in odd parts of the world.



The Soviet SU-76 was a wartime and rather rushed conversion of the T-70 light tank to carry a 76-mm field gun, and although it was produced in large numbers it was little liked by its crews, who called it the 'Bitch'.

SU-76s wait to take part in one of the massive artillery actions that usually took place before any major Red Army action. The open structure of the SU-76 must have made life very uncomfortable for their crews under such conditions, as only tarpaulin covers were carried.

Specification
SU-76
Type: self-propelled gun
Crew: 4
Weight: 10800 kg (23,810 kg)
Powerplant: two GAZ 6-cylinder petrol engines each developing 52.2 kW (70 hp)
Dimensions: length 4.88 m (16 ft 0.1 in); width 2.73 m (8ft 11.5 in); height 2.17 m (7 ft 1.4 in)
Performance: maximum road speed 45 km/h (28 mph); road range 450 km (280 miles); fording 0.89 m (2 ft 11 in)
Armament: one 76.2-mm (3-in) gun and one 7.62-mm (0.3-in) machine-gun

Red Army soldiers attack under the close supporting fire of SU-76 76-mm guns, providing a graphic example of what close-range artillery support really means. By 1945 the SU-76 was used almost exclusively in this role after being used at one point as mobile field artillery.

USSR

ISU-122 and ISU-152

The first of the heavy Soviet self-propelled artillery carriages was the **SU-152**, which first appeared in 1943, just in time to take part in the tank battles at Kursk. It was built onto a KV-2 heavy tank chassis and was typical of later World War II designs in that the tank chassis was taken virtually unchanged and a large armoured box was built on to the front of the hull. The weapon was a 152-mm (6-in) M-1937 howitzer mounted in a large and heavy mantlet on the front superstructure plate and there were roof hatches, one of which had provision for mounting an anti-aircraft machine-gun. This first vehicle was intended for use as much as an anti-armour weapon as a heavy assault weapon, for the Red Army made no differentiation between anti-tank and other weapons when it came to tactics. The SU-152 relied upon sheer projectile weight and power to defeat enemy armour.

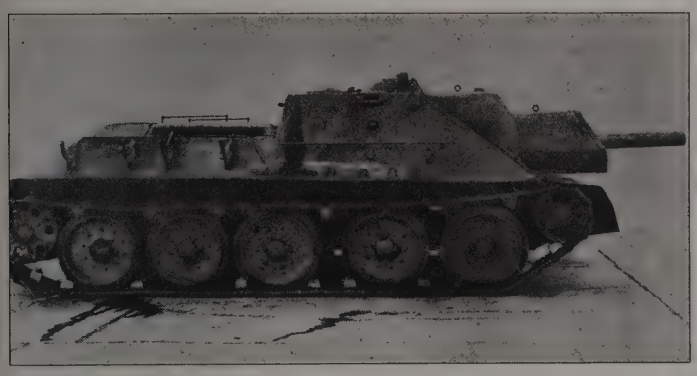
When the KV tank series was replaced in production by the IS series, these too were used for the SU self-propelled role. The conversion followed closely that of the original SU-152, and the IS-based conversion was originally known as the **ISU-152**. To the average observer the SU-152 and ISU-152 were visually identical, but the ISU-152 mounted a more modern howitzer known as the ML-20S (with 20 rounds), technically a gun-howitzer and a very powerful weapon, especially at the assault ranges favoured by Red Army tactics. The weapon was protected by an armoured box made up from sloping plates of thick armour, with hand rails around the edge of the roof for use by 'tank descent' infantry who used the vehicles to carry them into action. Maximum armour thickness was 75 mm (2.95 in).

The ISU-152 was joined by the **ISU-122**, a virtually identical vehicle carrying a powerful 122-mm (4.8-in) gun known as the M-1931/4 or A-19S (with 30 rounds), the ordnance being a modification of the then-standard 122-mm M-1931/37, though there was also another gun known as the D-25S which was ballistically identical to the A-19S but differed in the way it was constructed. Numerically the ISU-122 was less important than the ISU-152, but the 122-mm version was potentially the more powerful weapon as it fired a higher-velocity projectile than the heavier 152-mm weapon, which relied more upon shell weight for its effects.

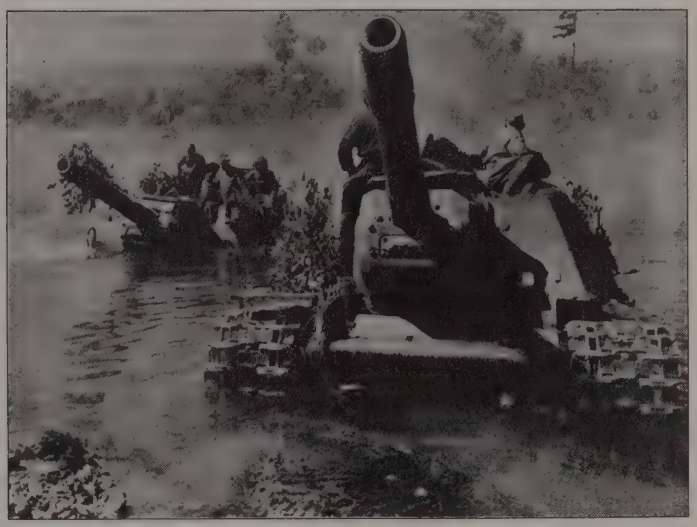
During 1944 and 1945 the ISU-152 and ISU-122 were in the vanguard of the Red Army advances through Germany towards Berlin. Some of the first Red Army units entering Berlin were ISU-152 units, which used their howitzers to blast away strongpoints at close ranges and clear the way to the remains of the city centre.

If the ISU weapons had a fault it was that they lacked internal ammunition stowage space. Thus they had to have a virtual constant supply of ammunition brought foward by armoured carriers, which was often a hazardous undertaking. But the massive weapon carried by the ISU vehicles was considered to be of great value in the direct support of Red Army tank and motorized infantry divisions, and both types went on to be used for some years after the war.

ISU-152s were still in front-line service in 1956 when the Red Army ruthlessly crushed the Hungarian uprising. In the streets of Budapest the lack of traverse proved a serious disadvantage. The gun mechanism was never modernized; elevation and loading were done by hand.



The SU-122 was a conversion of the T-34 tank to accommodate a front-mounted 122-mm howitzer in a well-armoured and well-sloped superstructure. It was produced in large numbers for the close-support role, but could be used for 'stand-off' artillery fire.

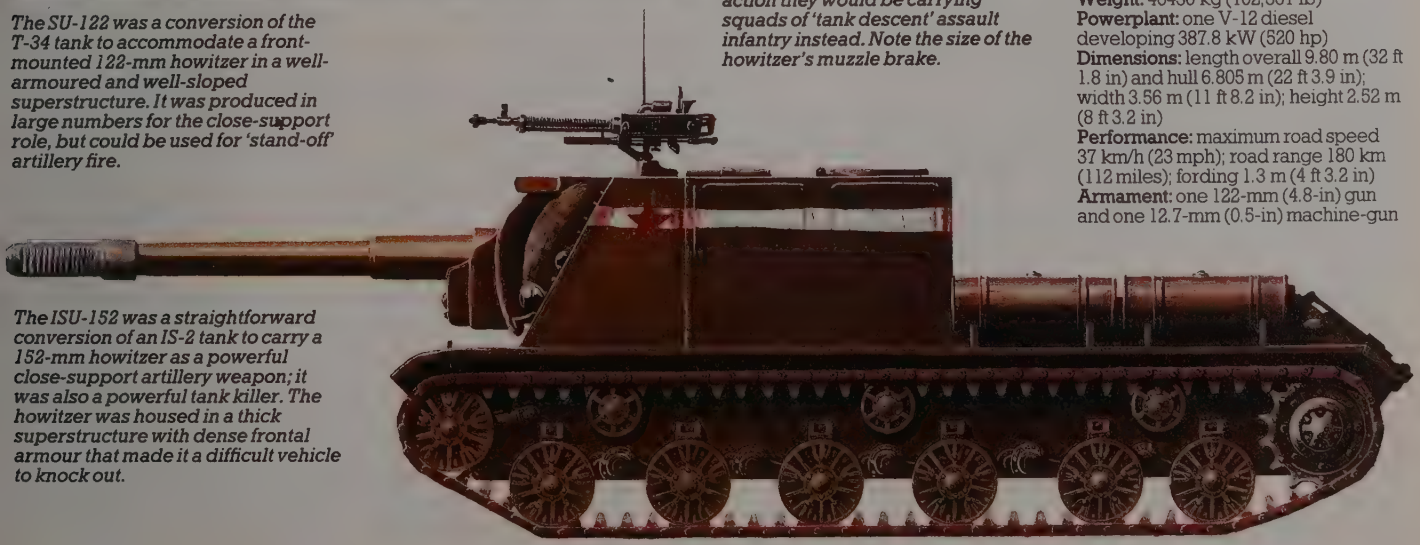


An ISU-152 crosses a river during the latter stages of World War II. These vehicles appear to be carrying their crew members on the roof, but in action they would be carrying squads of 'tank descent' assault infantry instead. Note the size of the howitzer's muzzle brake.

Specification

ISU-122

Type: self-propelled assault gun
Crew: 5
Weight: 46430 kg (102,361 lb)
Powerplant: one V-12 diesel developing 387.8 kW (520 hp)
Dimensions: length overall 9.80 m (32 ft 1.8 in) and hull 6.805 m (22 ft 3.9 in); width 3.56 m (11 ft 8.2 in); height 2.52 m (8 ft 3.2 in)
Performance: maximum road speed 37 km/h (23 mph); road range 180 km (112 miles); fording 1.3 m (4 ft 3.2 in)
Armament: one 122-mm (4.8-in) gun and one 12.7-mm (0.5-in) machine-gun



The ISU-152 was a straightforward conversion of an IS-2 tank to carry a 152-mm howitzer as a powerful close-support artillery weapon; it was also a powerful tank killer. The howitzer was housed in a thick superstructure with dense frontal armour that made it a difficult vehicle to knock out.

Guns of the Allies

Apart from Germany, the greatest exponents of self-propelled artillery were the Russians, who produced excellent vehicles in vast numbers. The British had to start from scratch, as did the USA, but the latter proved faster at producing a viable design.

It may seem strange to regard the Allies and the Soviets separately for the years between 1939 and 1945, for from 1941 onwards they were allied against the common German foe; but such was the isolation of the Soviet Union during much of the war that the Soviets can be considered as being militarily distinct for most practical purposes. Soviet armour development and its equivalent among the 'Atlantic' nations proceeded along entirely separate lines, and from different motivating factors. Thus although the Soviets and the Western Allies both produced self-propelled artillery, their products were quite different.

To start with the Soviet standpoint, it must be realized that armoured warfare had always featured large in Soviet long-term planning. From 1917 onwards the Red Army had been regarded as the vanguard of the Revolution and the missionary element that was to take the Soviet form of socialism to all corners of the earth, so it had to be equipped to carry through the class struggle. Amongst other factors, this meant for the Red Army planners the use of armoured warfare on a large scale. Over the USSR's early years this armoured ideal was sought but remained unrealized, for the simple reason that the decades after the Revolution were beset by international power struggles and by the problems associated with the upgrading of Soviet industry to a pitch where it could supply the weapons required for the forthcoming struggle. These strictures had several important results. One was a form of tactical and design orthodoxy that would not offend leaders' sensibilities or demand so many innovations that large-scale production of hardware would be slowed. Instead a steady programme of evolutionary development was adopted, whereby one established design was used as the basis for another, and mass production was channelled to accept such changes without any major disruption of production totals and norms. Thus Soviet armour designs tended to be strictly orthodox and based on a system of evolutionary change rather than a succession of new designs, one after another.

Self-propelled artillery had a place in Red Army philosophy from its earliest days. Soviet military leaders were thinking in terms of tank armies while planners in the West were tinkering with cardboard tanks and small numbers of tankettes. Fortunately for the West, Soviet industry was still in a formative stage during that period, but by the end of the 1930s armour was flowing from the newly-instituted production lines in an increasing torrent. Among these products were early attempts at self-propelled artillery. Many of these early design efforts were little more than design studies, for as a rule most Soviet tanks carried larger guns than their Western counterparts. They were usually simple conversions of existing tank chassis to carry pieces of ordnance already in production. Only one form of artillery on tracks got into production at this period and this demonstrated, for all its faults, the thinking that influenced Soviet self-propelled artillery design.

The weapon was the KV-2, which was in many respects a cross between a heavily-armed tank and a close-support assault weapon. The KV-2 carried a short 152-mm (6-in) howitzer in a large slab-sided rotating turret. Known to its crews as the 'dreadnought', the KV-2 was intended to move forward with other tanks and supply direct supporting fire at close ranges. This concept of heavy weapons employed well forward was to recur in later designs, and although later weapons were sometimes capable of indirect fire, Soviet self-propelled artillery was generally used in the direct-fire role and at the close ranges that demanded heavy protective armour for crew and weapon survival.

The KV-2 was not a success as its awkward and bulky turret made it an easy target during its main period of action, the campaign following the German invasion of 1941. During this invasion the Soviet Union lost nearly all its main industrial base in European Russia, together with many sources of strategic raw materials. What industrial potential there that remained in Soviet hands was uprooted and shifted at enormous physical cost to areas east of the Urals, where they were simply dumped and told to resume production. This disruption led to a drastic intensification of production priorities and aims: a stringent programme of choosing only a relatively few end products was imposed so that industry could concentrate on massive production of those alone; no diversion was possible. Ammunition supply followed the same lines to the extent that only a few calibres were selected for front-line use, so that production and logistic supply were made as easy as possible. In the field of armour the same policy was followed, although existing production vehicles and lines were retained. Thus the KV tank series remained in manufacture and the T-70 light tank lines were revised to produce the far more useful SU-76, but the main concentration was on the new T-34 tank, which also became the basis for one of the Red Army's most important self-propelled artillery weapons.

The crew of an SU-122 looks out for a potential target. The thick armour of the 122-mm howitzer mantlet is evident, along with the rather rough (but adequate) standard of finish of many Soviet weapons. The howitzer used was a modification of a standard field piece.

This was the SU-122, a T-34 tank altered to carry a 122-mm (4.8-in) howitzer in a well-sloped superstructure. It could be produced with relative ease on the T-34 lines, and it gave the Red Army armoured formations a powerful fire-support weapon. The SU-122 was used in exactly the same way as the earlier KV-2: well forward with the front waves of attacking tanks (usually T-34s) to blast away strongpoints or anything else that stood in the way of the advance. If an SU-122 broke down it could take parts from any disabled T-34 tank, and if ammunition ran out more could be picked up from any 122-mm howitzer battery in the vicinity.

The SU-122s were usually organized within regiments that contained two SU-122 batteries and two SU-76 batteries. The SU-76 was originally intended to be a stop-gap anti-tank weapon mounting a 76-mm (3-in) gun, but increases in German tank armour gradually relegated it to the close-support role. The SU-76

An M12 chocked securely in place with the rear firing spade lowered. The US Army was reluctant to take the M12 into service at first, but it proved to be invaluable, leading to the many later American designs. The M12 remained in service until 1945, mainly in Europe.

A parade-ground shot of an early M7, recognizable by the three-piece hull front – later models used a one-piece casting. The boxes on the hull in front of the driver's position were for spare track links.

A Bishop is seen in action during the latter stages of its operational career, close to Naples. The gun number is passing ammunition into the gun turret after taking it from ammunition limbers, one of which can be seen in the foreground and normally towed behind the vehicle when on the move.

and the SU-122 had one thing in common, and that was that they made no concessions whatsoever to crew comfort or convenience. Their crews went into action in vehicles that were roughly but adequately finished and inside or behind armour that was usually poorly ventilated, cramped and generally uncomfortable. Little consideration was given to access to ammunition lockers or to ease of handling, as the overwhelming need for mass production made such apparent luxuries unthinkable.

This trend continued with the SU-152 on the KV tank chassis (mounting a 152-mm/6-in howitzer) and the later ISU-152 (and its close counterpart the ISU-122) based on the IS tank chassis. The ISU-122 was produced mainly because there were stocks of 122-mm high-velocity guns ready to hand.

With these few vehicle and weapon combinations the Red Army carried the war into the heart of Germany by 1945. None of the vehicles used in the self-propelled artillery role was anything other than a modification of a vehicle already in mass production, and the number of types was kept as small as overall production totals were enormous.

The Western Allies

By contrast with the Soviets, the Western Allies were ill-organized for war. A long lapse into political thinking that regarded future wars as at best unlikely led their treasuries into releasing only limited defence funding, and as a result very little armoured warfare development was carried out in either the USA or the United Kingdom during the 1920s and 1930s. The British army did make a tentative stab at developing self-propelled artillery with the Birch Guns during the late 1920s, but the effort came to nothing when the money ran out. What later became the Western Allies did make great steps towards mechanization, to the point where the little BEF that went to France in 1939 was the only fully-mechanized component of all the Allied forces facing Germany. But the artillery was still towed, albeit behind mechanized tractors. Self-propelled artillery did not feature at all in the armies of 1940, apart from a few World War I weapons still in use by the French.

The campaign of May 1940 changed all that. The Panzer divisions swept across France and demonstrated the catastrophic arrival of a new concept of warfare, based on the tank. But if the future pace of warfare was to be dictated by the tank, it was abundantly clear that all other arms had to keep up with them, and that included the artillery. For the British army during the days after Dunkirk sheer survival and re-equipment were the paramount factors, and matters such as new forms of artillery had to wait.

The USA started war production for the British and French during early 1940, but the nation deluded itself that it could remain aloof from events across the oceans until Pearl Harbor inflicted the awful truth. The USA then perforce entered the war, and the world's mightiest industrial nation swung into action almost overnight. Within weeks tank and weapon factories were being built all over the nation, even though it had not been decided what form or type of weapons were to be produced in them. Before long new types of tank were flowing off the brand-new lines, though it soon became obvious that good as some of these new designs were, they lacked any form of long-term design or tactical experience for guidance: by 1941 the Soviet Union and Germany were already mass-producing tanks from scratch, whereas the USA was at the stage of virtually hand-building test prototypes. Thus compared with many contemporary German or Soviet designs, some of the early American equipments were undergunned and overengineered, but they had the priceless advantage that they were available in potential masses.

The first Allied attempt at self-propelled artillery came from the USA, where World War I 75-mm (2.95-in) guns were placed on halftracks and rushed into service of a sort, although none saw other than limited action. A British equivalent (in awkwardness if not calibre) was the odd 25-pdr Bishop, which equalled many of the later German lash-ups in strange appearance and lack of tactical utility, as when it was first mooted no one could decide if it was to be a heavy-gun tank or self-propelled artillery. The Bishop was the only type of British self-propelled artillery to see service before the end of the war, for thereafter the British gunners relied on the output of Sextons from the Canadian factories and numbers of American weapons, especially the M7, known to the British as the Priest.

The M7 was the outcome of an earlier American programme in which a 105-mm (4.13-in) howitzer was placed on a halftrack and designated T19. (The earlier 75-mm halftrack was the T12.) These saw service during the Tunisian campaign, in which they were joined by the M7 Priest. Built on the M3 medium tank chassis (and later the M4) the M7 was a great success and carried a 105-mm howitzer. Although it had been manufactured using an existing chassis, the M7 used spare production potential as it appeared at a time when the M3 was being phased out, and it differed in many ways from its Soviet equivalant.

First there was the tactical role that the M7 was supposed to play: whereas the Soviet weapons were supposed to produce direct close-up supporting fire, the M7 and the later Allied designs were designed to act as truly mobile pieces of field artillery for long-range indirect fire, and as such played no direct part in assault or close combat. Neither did they have an anti-tank role, although if a target presented itself it was usually engaged. Thus the armour of the M7 was much lighter than the essential carapaces of the Soviet assault guns. The M7 and its close Canadian counterpart had only light front and side armour and no overhead cover at all.

The M7 was just one of many American self-propelled artillery designs. A listing of all the prototypes and trial models produced by the Americans would cover pages, and few of them ever got past the 'one-off' stage. But they all had one thing in common, apart from the purely anti-tank versions, in that they were all intended only for the indirect-fire role. They were nearly all superbly produced and detail engineering reached down as far as crew comforts. So there cannot be any close comparison between Soviet and Western designs: they were the results of different concepts of production thinking, and in the end were used for wholly different tactical purposes.

CANADA

Sexton

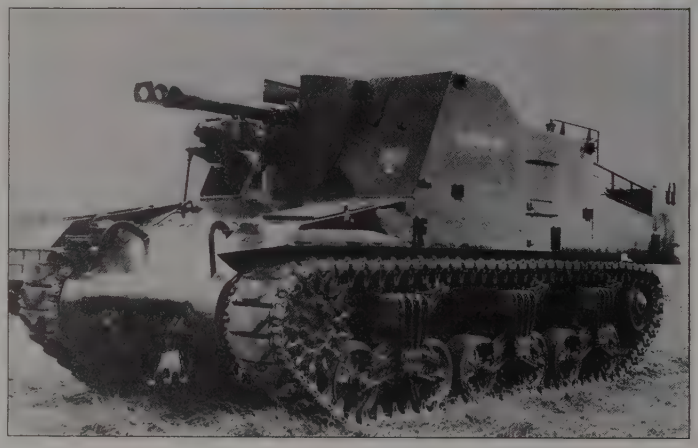
Above: The Sexton mounted the British 25-pdr gun and was a well-liked and reliable vehicle that served on for many years after World War II with many armies. It is still used by India.

During early 1941 the British Purchasing Commission in Washington asked the Americans if the M7 Priest could be altered to allow it to carry the British 25-pdr (87.6-mm/3.45-in) gun-howitzer. While the British appreciated the amenities of the M7 Priest, it had the major disadvantage of mounting a 105-mm (4.13-in) howitzer that was not a standard British weapon calibre at that time. The Americans accordingly produced the M7 with the 25-pdr and named it the T51, but at the same time announced that there was no way that they could produce it in quantity as they had their production hands full already. The British accordingly looked around and noted that the Canadians had set up a production line for the Ram tank, a type that was soon to be replaced by the American M3 and M4. The Ram was accordingly altered to accommodate the 25-pdr, and thus was born the **Sexton**.

The Sexton used the overall layout of the M7 Priest, but many changes were introduced to suit British requirements. These included the movement of the driver's position to the right-hand side. The Sexton lacked the pronounced 'pulpit' of the M7, but the fighting compartment was left open with only a canvas cover to provide weather protection for the crew. The Sexton had a crew of six, and much of the interior was taken up with lockers for ammunition and some of the crew's personal kit; more stowage was provided in boxes at the rear. Maximum armour thickness was 32 mm (1.25 in).

The 25-pdr gun-howitzer was carried in a special cradle produced by the Canadians specifically for the Sexton. This allowed a traverse of 25° left and 40° right, which was very useful for the anti-tank role (18 AP rounds) but in the event the Sexton had little need of this facility. Instead it was used almost exclusively as a field artillery weapon (87HE and smoke rounds) supporting the armoured divisions in North West Europe from 1944 onwards. There were several variations, all of them incorporating the production changes progressively introduced on the lines of the Montreal Locomotive Works at Sorel. Production continued there until late 1945, by which time 2,150 Sextons had been manufactured.

The Sexton was a well-liked and reliable gun and weapon combination that proved so successful that many are still in use in odd corners of the world to this day. The British army used the type until the late 1950s, and one is preserved as a museum piece at the Royal School of Artillery at Larkhill in Wiltshire.



This Sexton is now a preserved 'runner' maintained by the Royal School of Artillery at Larkhill, Wiltshire. It originally came from Portugal, where it was sent during the years after 1945.

There were a few in-service variants of the Sexton, some being converted to 'swim' for possible use on D-Day, but none appear to have been used in this role on the day. A more common conversion was the replacement of the gun-howitzer by extra map tables and radios in the **Sexton Gun Position Officer** command vehicle; there was usually one of these to a battery. In post-war years some Sextons were handed over to nations such as Italy who preferred the 105-mm (4.13-in) howitzer; in this instance the 25-pounders were replaced with German 105-mm howitzers.

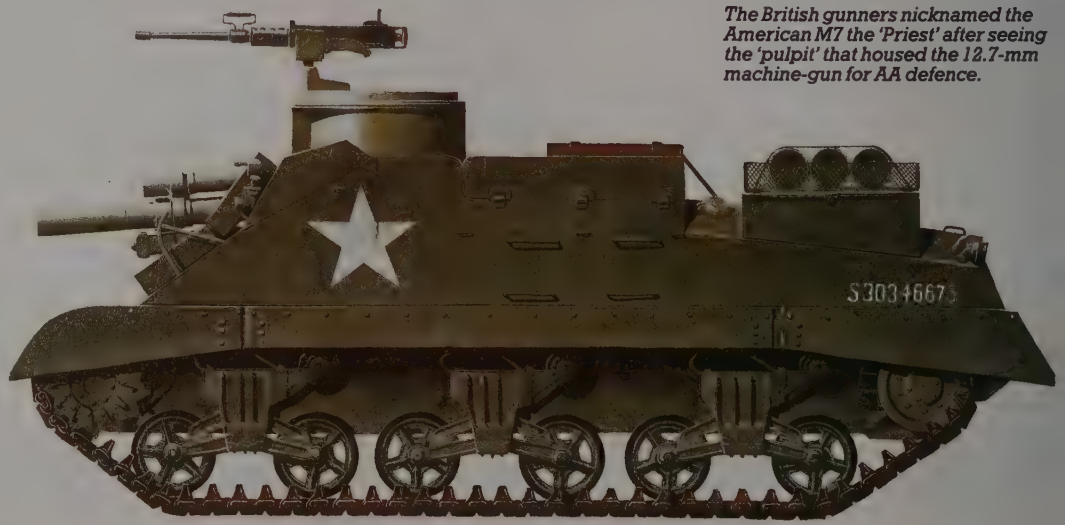
Specification

Sexton

Type: self-propelled gun-howitzer
Crew: 6
Weight: 25855 kg (57,000 lb)
Powerplant: one Continental 9-cylinder radial piston engine developing 298.3 kW (400 hp)
Dimensions: length 6.12 m (20 ft 1 in); width 2.72 m (8 ft 11 in); height 2.44 m (8 ft 0 in)
Performance: maximum road speed 40.2 km/h (25 mph); road range 290 km (180 miles); fording 1.01 m (3 ft 4 in)
Armament: one 25-pdr gun-howitzer, two unmounted 7.7-mm (0.303-in) Bren Guns and (on some vehicles) one pintle-mounted 12.7-mm (0.5-in) Browning machine-gun

USA

M7 Priest



The British gunners nicknamed the American M7 the 'Priest' after seeing the 'pulpit' that housed the 12.7-mm machine-gun for AA defence.

Experience gained with 105-mm (4.13-in) howitzers mounted on halftracks enabled the US Army to decide that it would be better if the howitzer was mounted in a fully tracked carriage,and accordingly an M3 medium tank chassis was modified to take such a weapon. The M3 chassis was considerably reworked to provide an open-topped superstructure with the howitzer mounted in its front. The development vehicle was known as the **T32**, and following trials which added a machine-gun mounting to the right-hand side of the fighting compartment, the vehicle was adopted for service as the **Carriage, Motor, 105-mm Howitzer, M7**. Maximum armour thickness was 25.4 mm (1 in).

The first production examples were for the US Army, but many were soon diverted to the Lend-Lease programme for the Allies, among them the Brit-

ish Army. The British soon named the M7 the **Priest**, legend having it that the prominent machine-gun mounting gave the impression of a pulpit. The British gunners adopted the M7 with alacrity, and the type first went into action with them at the 2nd Battle of El Alamein in October 1942. The British asked for 5,500 M7s to be produced for their use alone by the end of 1943, but this order was never completed in full. The figure nonetheless provides an indication of the success of the M7 with the British gunners. They appreciated the space and mobility of the carriage and also the extra space for personal stowage. The one snag was the howitzer, which was not a standard British Army type: thus ammunition (stowage was provided for 69 rounds on each vehicle) had to be supplied separately for the M7 batteries, which made for a considerable logistic complication. This was not resolved until the first Sextons with the 25-pdr weapons began to be issued in 1944. Until that time the British M7s were used all through the Italian campaign, and some were landed in Normandy in June 1944 though they were soon replaced by Sextons.

The M7 then began a new service career in a revised form: the howitzers were removed and the hulls were used as armoured personnel carriers nicknamed Kangaroos. This soon became a normal fate for unwanted M7s, and the idea soon spread to Italy.

The US Army also made wide use of the M7, although production for the US Army was not a constant process. After 1942 M7 production proceeded in fits and starts. At one stage the original M3 chassis was replaced by the later M4A3 Sherman chassis, and these M7s were known by the designation **M7B1**.

After 1945 large numbers of M7s were handed over to other countries, and some remain in use to this day in such nations as Brazil and Turkey. The 105-mm howitzer is still a standard weapon all over the world, and thus the M7s continue to fire a 14.97-kg (33-lb) shell to a range of 11430 m (12,500 yards). Throughout their service life the M7s have always showed outstanding reliability, and have demonstrated their ability to cross all types of rough terrain.

An M7 in action in the Ardennes, 1945, with the open fighting compartment covered by a tarpaulin to keep out the worst of the bitter weather. The tank obstacles behind the M7 are part of the infamous Siegfried Line defences that in the event were taken without too much trouble.

Specification
M7
Type: self-propelled howitzer
Crew: 5
Weight: 22967 kg (50,634 lb)
Powerplant: one Continental 9-cylinder radial piston engine developing 279.6 kW (375 hp)
Dimensions: length 6.02 m (19 ft 9 in); width 2.88 m (9 ft 5.25 in) height 2.54 m (8 ft 4 in)
Performance: maximum speed 41.8 km/h (26 mph); maximum road range 201 km (125 miles); fording 1.219 m (4 ft)
Armament: one 105-mm (4.13-in) howitzer and one 12.7-mm (0.5-in) machine-gun

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USA

Carriage, Motor, 155-mm Gun, M40

The first 155-mm (6.1-in) self-propelled gun produced in quantity by the Americans during World War II was the **M12**, a design originally known as the **T6** and built on to a converted M3 medium tank chassis. Initially this weapon was not considered for service as it used an obsolescent World War I ordnance that had become available once the type's original carriages had become too worn for further use. However, once accepted for service, they gave good performance although it was agreed that a new ordnance was required if a long-term weapon was to be procured.

Starting in December 1943 a new weapon/carriage combination was initiated. The gun was the 155-mm M1A1 known as the 'Long Tom' (with 20 rounds) and the carriage was based on the chassis of the M4A3 medium tank, though much widened and fitted with the latest high volute suspension springing. The engine was moved from the rear to a new forward position, and to absorb some of the recoil forces a spade was added to the rear; this latter could be raised for travelling. A working platform under the breech was also provided. The gun had a range of 23514 m (25,715 yards) and fired a projectile weighing 43.1 kg (95 lb), which made it a very useful counterbattery and long-range bombardment weapon. Maximum armour thickness was 12.7 mm (0.5 in)

The development of this **Carriage, Motor, 155-mm Gun, M40** took rather longer than expected, so it was not until January 1945 that the first production examples rolled off the lines. They were rushed across the Atlantic in time to see the end of the war in Germany.

Although the M40 arrived on the scene later in the war, it was one of the best of all wartime self-propelled equipments and went on to a long post-war career. It used the chassis of the M4 tank as a basis.

M40s took part in the bombardment of Köln and the short campaigning after this. Between January and May 1945 no less than 311 M40s were built, and production continued after the war. The M40 was to see its most concerted use during the Korean conflict, where it proved to be an excellent weapon/carriage combination.

On the M40 there was no protection for the crew as the type was designed for use so far behind the front line that none would be necessary. The M40 had a crew of eight, and there was provision on the carriage for their weapons and kit. The same carriage was also used to mount a 203-mm (8-in) howitzer, but this version (the **Carriage, Motor, 8-in Howitzer, M43**), was not used in great numbers; only 48 were built.

After 1945 M40s were distributed to many other armies. The British Army accepted a number and used them for some years. More were used by nations such as France, with whom the type saw extensive service in Indo-China.

There was one variant of the M40, the **T30 Cargo Carrier**. As its designation implies, it could be used as a general supply carrier though its normal deployment was for the ammunition supply of M40 batteries. Not many were built as most of the manufacturing potential was concentrated on producing gun carriers.

One of the main claims to importance of the M40 was that it paved the way for the current generation of self-propelled weapons. It was produced at a time when nuclear warfare was just making its debut, and the need for protection against this new battle hazard was particularly noticeable on the M40 with its open fighting platform. The type was therefore used extensively for trials and experiments designed to provide protection for the crew. The M40 proved beyond doubt that the only proper protection comes from an armoured turret, and most modern self-propelled weapons now use such an arrangement.

Specification
M40
Type: self-propelled gun
Crew: 8
Weight: 37195 kg (82,000 lb)
Powerplant: one Continental 9-cylinder radial piston engine developing 294.6 kW (395 hp)
Dimensions: length overall 9.04 m (29 ft 8 in) and hull only 6.65 m (21 ft 10 in); width 3.15 m (10 ft 4 in); height 2.84 m (9 ft 4 in)
Performance: maximum speed 38.6 km/h (24 mph); range 161 km (100 miles); fording 1.067 m (3 ft 6 in)
Armament: one 155-mm (6.1-in) gun

UK

Bishop

The vehicle that became known as the **Bishop** was conceived at a time when 25-pdr batteries in the North African desert were perforce used as anti-tank weapons and were taking a terrible pounding as a result. It was decided to place the 25-pdr on a mobile carriage to increase protection for the gun crews, and it was soon clear that the Valentine infantry tank would make a good basis for such a conversion. Unfortunately the exact role of this gun/tank combination was uncertain from the start. The tank exponents saw it as a variant of the heavy-gun tank theme, while the gunners wanted a self-propelled carriage. These arguments were never really solved, and the result was something of a compromise even though the gunners won in the end.

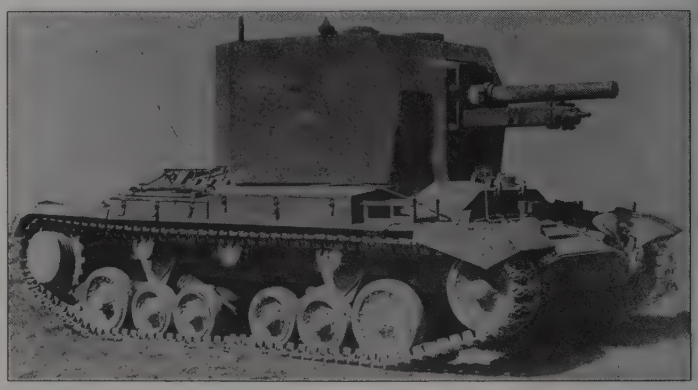
The Valentine 25-pdr emerged as a straightforward conversion (officially the **Mounting, Valentine, 25-pdr Gun Mk I on Carrier, Valentine, 25-pdr Gun, Mk I**) the usual turret being replaced by a much larger turret mounting the 25-pdr. This new turret was fixed, and was a large slab-sided design too large for battlefield concealment and too small to allow much room inside for the gun crew. The turret design also had one major disadvantage for the gunners in that it restricted the elevation of the barrel and thus curtailed range to only 5852 (6,400 yards) which was a considerable reduction from the normal 12253 m (13,400 yards). The only way to increase this performance was the tedious and tactically-hampering construction of earth ramps up which the vehicle could be driven to increase the elevation angle. Traverse was also severely restricted, to a maximum of 4° to each side. Internal ammunition stowage was 32 rounds but more could be carried in a limber towed behind the vehicle. Armour varied in thickness from 8 mm (0.315 in) to 60 mm (2.36 in).

The 25-pdr Valentine went into action in North Africa during the latter stages of the campaign in that theatre, by which time the 25-pdr was no longer in use as an anti-tank gun, so the vehicles were used as self-propelled artillery with no distraction and the Royal Artillery learned a lot from their use. The type was eventually named Bishop, and it went on to be used in Sicily and Italy during the opening stages of that campaign. Throughout these campaigns the Bishop demonstrated all its several drawbacks, but also provided an indication of the potential of self-propelled artillery for it was the first British self-propelled weapon to see active service. The need for supporting logistics was more than emphasized, as was the need for improved radio links with forward observers.

The Bishop also demonstrated things to avoid in future designs. The most obvious one was for the gun to have its full range of movement if it was to be of any use; additionally, more room was needed to serve the gun, for the turret of the Bishop was cramped and ill-ventilated. More internal ammunition stowage was needed and the carrier had to be fast enough to keep up with tanks. Being an infantry tank, the Valentine chassis was too slow to keep up with the armoured formations.

All these things were put right when the gunners were issued numbers of M7 Priests. The gunners took to the Priest with a will, and before long the Bishops had been discarded. They may have been less than perfect, but they taught the gunners a lot and the Bishop has the distinction of being the British Army's first self-propelled artillery piece.

Above: A Bishop on the ranges with the gun detachment commander outside the fixed turret, as there was room for only two gunners inside. The fixed turret restricted the barrel elevation and thus range.



Above: This Bishop in 'factory' state clearly shows the high and bulky outline of the fixed turret mounting the 25-pdr gun. As this was a 'first attempt' design there was confusion as to whether the Bishop was a heavy gun tank or a self-propelled gun, but in the end the gunner's view prevailed.

Above: Ammunition stocktaking takes place on a Bishop with the projectiles laid out on the engine covers for counting. The Bishop could carry only 32 rounds internally, as space inside the fixed turret was cramped. The projectiles are 25-pdr HE shells, the normal round fired, although smoke could also be carried.

Below: The Bishop was an early British attempt to produce self-propelled artillery by placing a 25-pdr gun onto a Valentine tank chassis. The gun was mounted in a fixed turret with only limited elevation and the result was not a success, being replaced in service by the Priest as soon as possible.

Specification
Bishop
Type: self-propelled gun-howitzer
Crew: 4
Weight: 7911 kg (17,440 lb)
Powerplant: one AEC 6-cylinder diesel developing 97.7 kW (131 hp)
Dimensions: length 5.64 m (18 ft 6 in) width 2.77 m (9 ft 1 in); height 3.05 m (10 ft)
Performance: maximum road speed 24 km/h (15 mph); road range 177 km (110 miles); fording 0.91 m (3 ft)
Armament: one 25-pdr (87.6-mm/3.45-in) gun-howitzer

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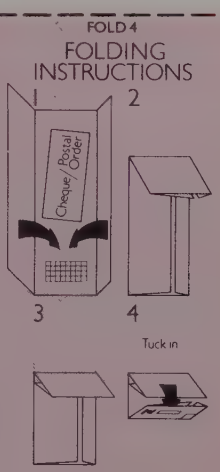

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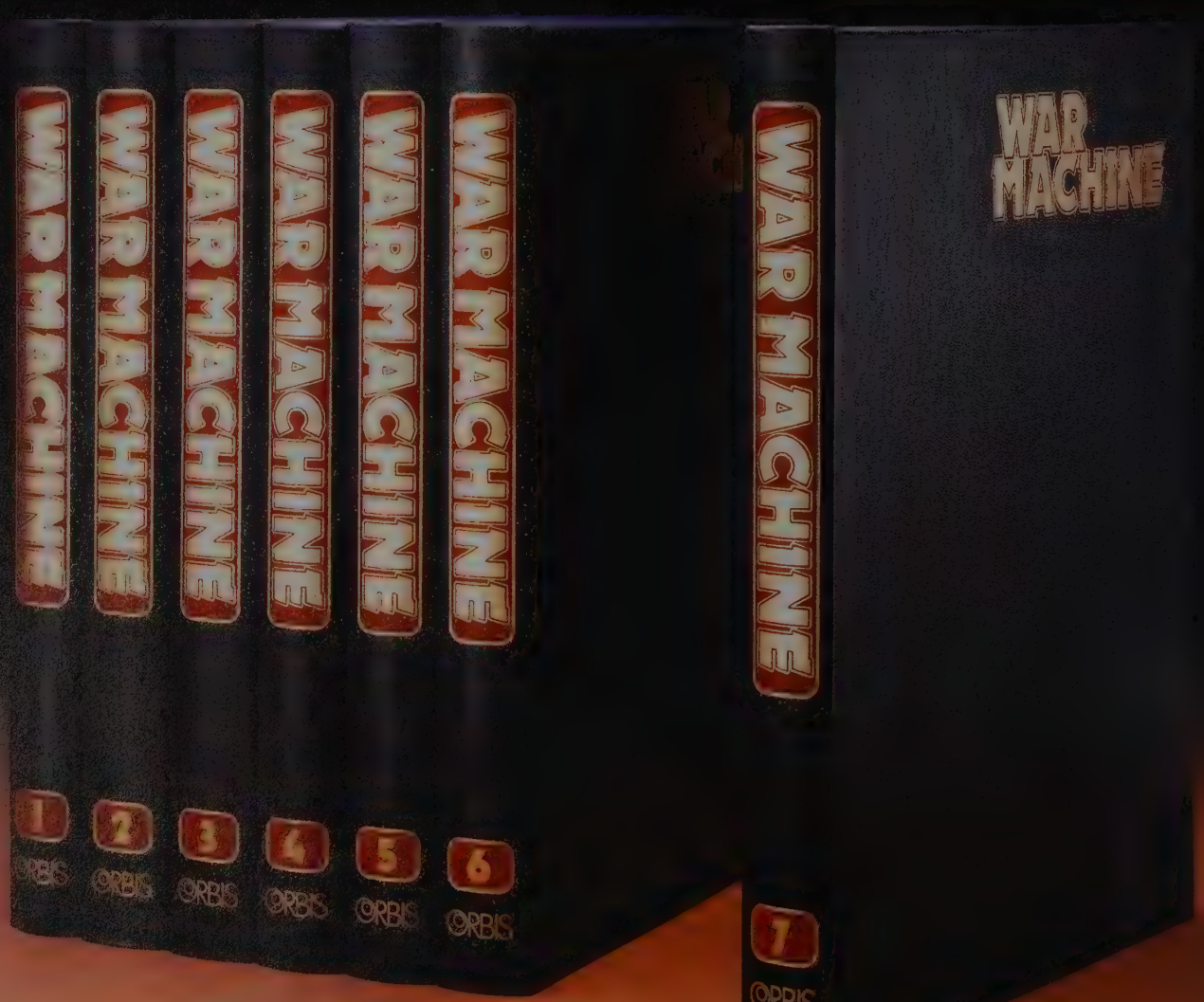

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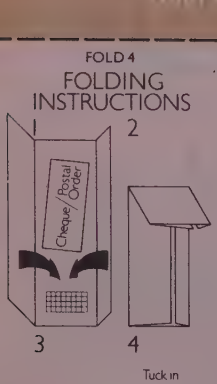

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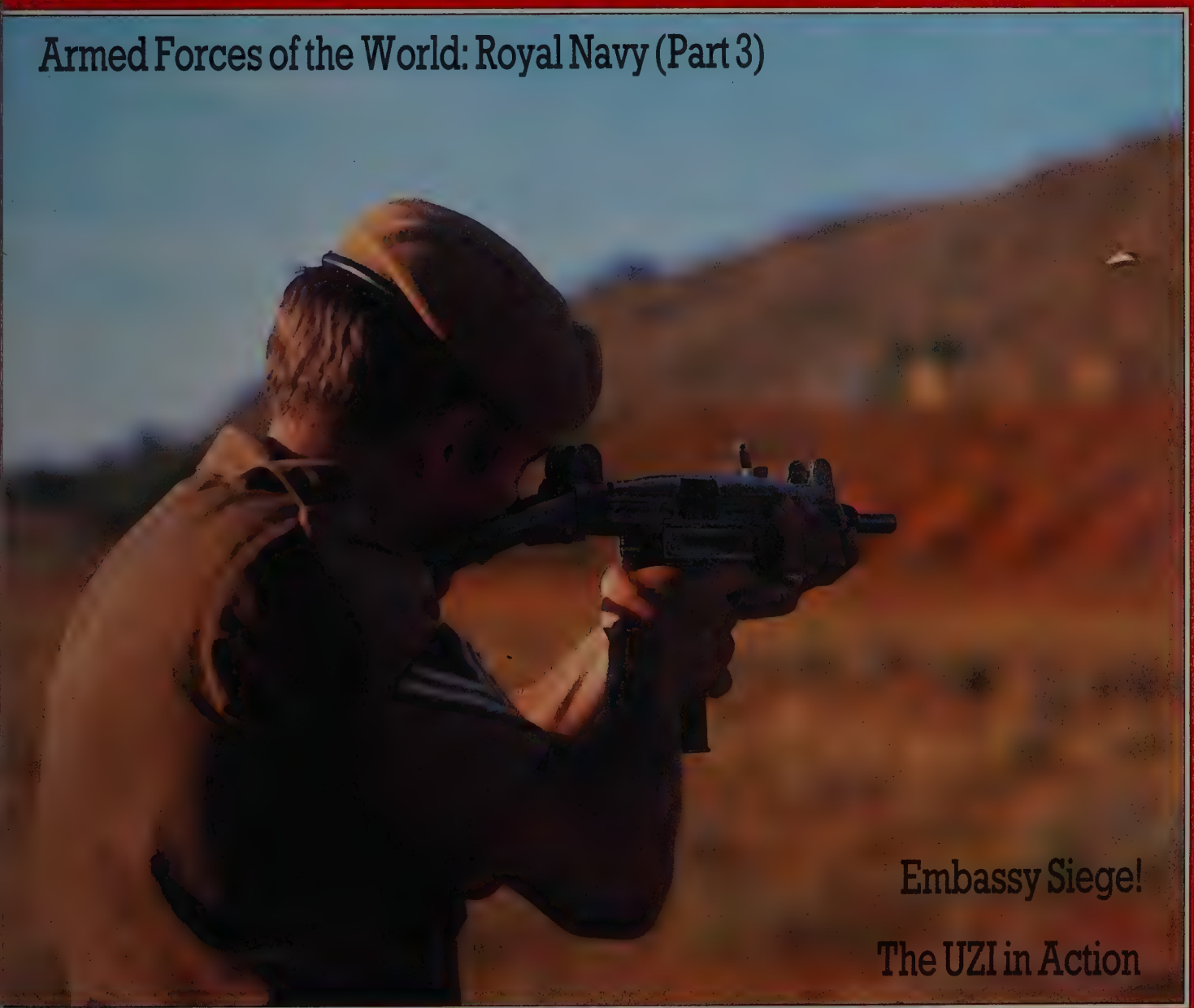

Embassy Siege!

The UZI in Action

A fully illustrated guide to Modern Sub-Machine Guns

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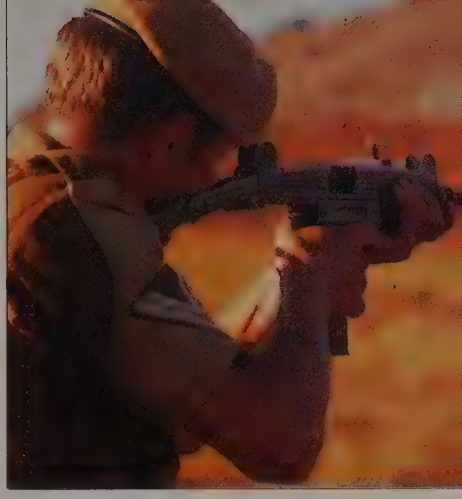
Modern Sub-Machine Guns



Evolved through necessity in the confined spaces of the trenches during World War I, the sub-machine gun has found a useful place in modern armed forces. Small, cheap and easily concealed, it is an ideal weapon for facing the urban terrors of the latter half of the 20th century.

South Africa is one of the many nations to use the Israeli UZI. First seeing major service in the 1956 Arab-Israeli conflict, the UZI is one of the most successful post-war sub-machine gun designs.

Ever since the assault rifle became a viable weapon during the latter stages of World War II the pundits have been saying that the sub-machine gun's day was over. The trouble is that no one seems to have told the designers of small arms or the men who use sub-machine guns. Today the numbers of sub-machine guns on the market are as high as ever, and more seem to appear each year. The modern sub-machine guns described in this issue are but a few of the more important types currently in use. There are many more types around, some of them having been in service since World War II, but most of the types described are of a much more sophisticated form. All manner of detail design features have been introduced to differentiate them from the hasty tube and sheet metal designs of World War II, although the same basic manufacturing principles are often used. Today there is more time to apply better finishes and construction methods, but while costs may have risen somewhat since World War II the modern sub-machine gun is still a relatively cheap weapon. Perhaps it is this that ensures the longevity of the type.

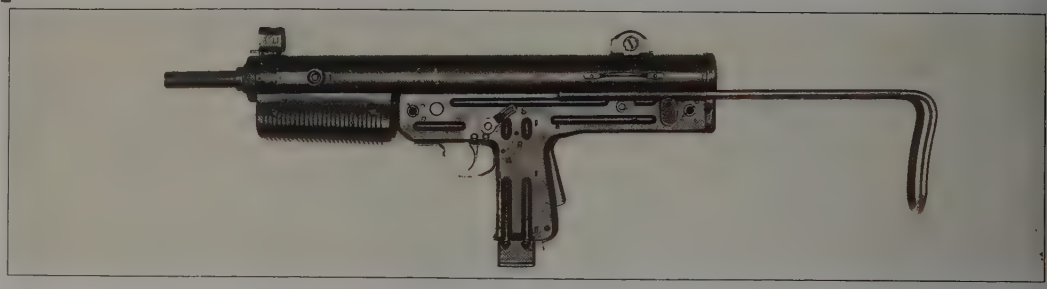
But it cannot be cost alone that maintains the sub-machine gun in use all over the world. Despite the many advantages that the assault rifle has to offer, it is still a complex and lengthy weapon that is nowhere near as effective in close-quarter fighting as the sub-machine gun. Despite the increases in weapon power achieved in recent years, many combats still take place at close ranges and here the sub-machine gun is still as effective as it was when it was produced to 'sweep trenches of the enemy' during World War I. The short and handy sub-machine gun still reigns supreme in such circumstances.

Today the sub-machine gun is carried by one new operator, the policeman or the member of a security organization. The growth of national and international terrorism in recent years has meant that the agencies set against it have to be armed as effectively as their highly organized and well-armed opponents. Thus the sub-machine gun has assumed a new and dangerous era, and it may be many years (if ever) before the weapon is no longer used in this relatively new and but dreadfully public cockpit.

Outside the Washington Hilton, 30 March 1981, President Reagan has just been shot; his assailant is buried under a swarm of police and secret service men. Prominent is the Israeli-made UZI sub-machine gun, carried by the agent in the foreground.

ARGENTINA

9-mm PA3-DM



The Argentine **PA3-DM** is a typical example of modern sub-machine gun design in two respects; one is the use of the forward-mounted 'wrap-around' breech block and the other the ability of a relatively unsophisticated engineering industry to produce modern and viable weapons.

The 'wrap-around' bolt is now a virtual fixture on many modern sub-machine guns, for it provides two important functions. One is that the breech block is to a large extent forward of the chamber when the cartridge is fired, so providing extra mass for the recoil to overcome, thereby providing an increase in locking efficiency for what is otherwise a relatively effective but inefficient blowback system. The other advantage is that by placing much of the breech block around the barrel the weapon length can be much reduced, making the overall design shorter and handier for carriage and stowage. Nearly all these 'wrap-around' designs, and the PA3-DM is no exception, use the pistol grip as the magazine housing, and this has the advantage of allowing rapid aiming, for by holding the weapon with the 'master' hand, one-handed firing is possible as though the weapon is a pistol.

The first weapon to use this 'wrap-around' feature was the Czech vz 23 series, and it has appeared on many subsequent weapons. The Argentine design closely follows the Czech original in overall construction, for it relies on the use of simple stampings and has as its receiver housing nothing more than a section of steel tubing. The PA3-DM has its cocking handle on the left-hand side well forward so that it can be operated by either hand, and a hand grip is provided forward of the metal pistol group assembly. The PA3-DM may be found in two forms: one has a fixed plastic butt, while the other has a wire-form butt which telescopes forward on each side of the receiver. This latter is a direct copy of the wire butt used on the American M3 sub-machine gun. On both versions the barrel screws onto the front of the tubular receiver and the barrel can be adapted to mount a device for launching grenades.

The PA3-DM was used during the Falkland Islands campaign of 1982, though not in very great numbers. Some 'trophies' were returned to the United Kingdom and may be found in some regimental museums, but otherwise it is not a weapon that is likely to be encountered outside Argentina, where it is issued to the armed forces.

The PA3-DM is manufactured by the Fabrica Militar de Armas 'Domingo Matheu' at Rosario, from which the 'DM' of the designation is derived. It is only the latest model in a long string of sub-machine guns that have been designed and produced in Argentina since the period just after World War II. Many of these sub-machine guns were orthodox designs with little of note to mention, and not all of them reached the full production stage. Some were direct copies of successful designs elsewhere: for example, the **PAM 2** dating from the early 1950s was nothing more than a direct copy of the US M3A1 calibred in 9 mm (0.354 in). Some of the other designs, such as the **MEMS** series and the **Halcon** guns, were more adventurous designs that made little impact outside Argentina.

Captured by British forces on the Falklands during the South Atlantic conflict, the PA3-DM exemplifies the modern sub-machine gun, being simply designed and easy to manufacture.

Specification

PA3-DM (fixed-butt version)
Calibre: 9 mm (0.354 in) Parabellum
Weight: loaded 3.9 kg (8.6 lb)
Length: 700 mm (27.56 in)
Length of barrel: 290 mm (11.4 in)
Muzzle velocity: 400 m (1,312 ft) per second
Cyclic rate of fire: 650 rpm
Magazine: 25-round box

UK

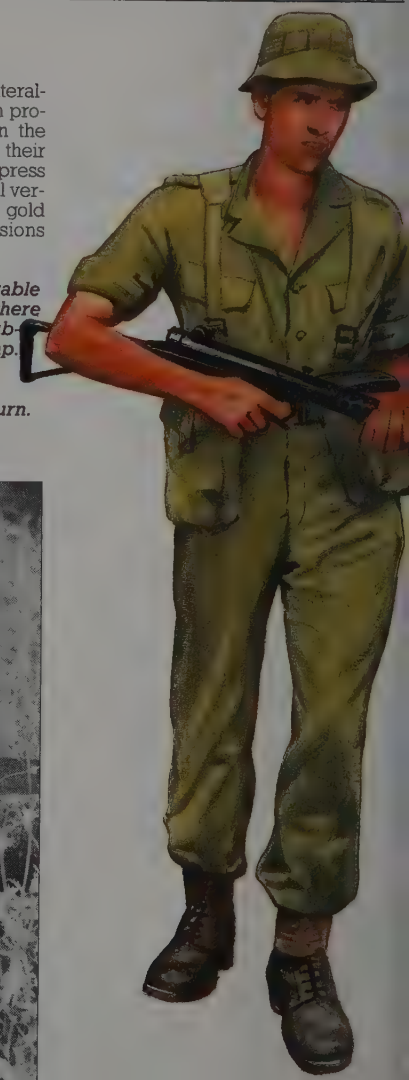
9-mm L2A3 Sterling

The sub-machine gun that is now almost universally known as the **Sterling** entered British Army use in 1955 although an earlier form, known as the **Patchett**, underwent troop trials during the latter stages of World War II. It was intended that the Patchett would replace the Sten gun, but in the event the Sten lasted until well into the 1960s.

The British army model is designated the **L2A3** and equates to the **Sterling Mk 4** produced commercially by the Sterling Armament Company of Dagenham, Essex. This weapon is one of the major export successes of the post-war years, for to date it has been sold to over 90 countries and it is still in production in several forms. The basic service model is of simple design with the usual tubular receiver and a folding metal butt stock, but where the Sterling differs from many other designs is that it uses a curved box magazine that protrudes to the left. This arrangement has proved to be efficient in use and presents no problems. It has certainly created no problems for the army in India where the type is produced under licence, or in Canada where the design is produced as the **C1** with some slight modifications.

The Sterling is a simple blowback weapon with a heavy bolt, but this bolt incorporates one of the best features of the design in that it has raised and inclined splines that help to remove any internal dust or dirt and push it out of the way. This enables the Sterling to be used under the worst possible conditions. The usual magazine holds 34 rounds, but a 10-round magazine is available along with a string of accessories including a bayonet. The weapon can be fitted with any number of night vision devices or sighting systems, although these are not widely used.

Several variants ot the Sterling exist. One is a silenced version known to the British army as the **L34A1**. This uses a fixed silencer system allied to a special barrel that allows the firing gases to leak through the sides of the barrel into a rotary baffle silencer that is remarkably efficient and almost silent in use. There is also a whole range of what are known as paratrooper's pistols that use only the pistol group and the receiver allied to a short magazine and a very short barrel. These are available in single-shot or machine pistol versions. Several types of finish are produced, including what must be that for the most luxurious of sub-machine guns, for one version is literally gold-plated. These have been produced for various potentates in the Middle East who use them for their personal bodyguards and to impress visitors; both silenced and normal versions have been produced with gold plating. Chromium-plated versions have also been made.



Right: The Sterling saw considerable service in Malaya and Borneo, where the inherent inaccuracy of the sub-machine gun proved no handicap.

Below: The Sterling is seen on exercise in the UK, at Bassingbourn. It is being replaced by the new Enfield Individual Weapon.

Machine Pistols

The virtues of the sub-machine gun in close-quarter combat soon led designers to attempt to turn the contemporary self-loading (or automatic) pistol into a fully automatic weapon.

Almost as soon as the automatic pistol was first produced designers were tempted into allowing their progeny to fire in fully automatic bursts. The conventional automatic pistol simply fires a round, re-cocks itself and loads another round ready to fire on the repeated pull of a trigger. By simply keeping the trigger mechanism out of the way it was (and is) easy to allow the pistol to produce burst fire, but the designers soon learned that this was not a course to be undertaken lightly.

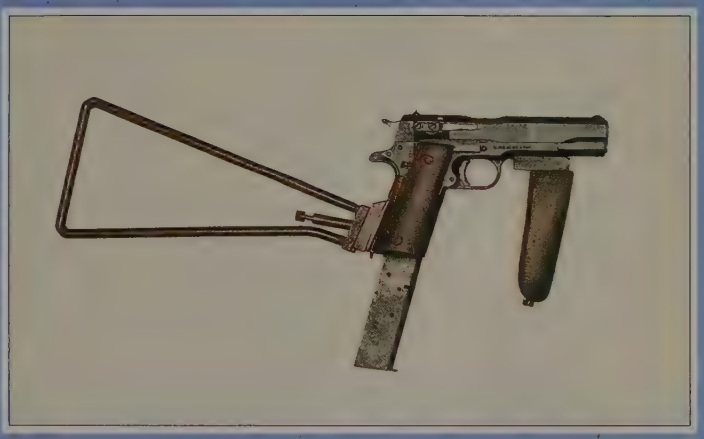
The pistol cartridge is weak compared with a rifle cartridge, but can still produce considerable recoil forces. If such cartridges are fired in rapid succession they can soon overcome the mass of a light hand-held pistol and force the muzzle to rise or jump about erratically. In either case aimed fire becomes almost impossible. Moreover, the bolts of most pistols are light, and this allows full automatic fire to be very rapid indeed, to the extent that the limited ammunition capacity of most pistols will be used in less than a second. These two limitations have made the machine pistol something of a rarity among combat weapons, but the machine pistol has nonetheless turned up throughout small arms development.

The first of the machine pistols to be used on any large scale were the Mausers. Derived from the C/96 pistols, the *Schnellfeuer* (quick fire) pistols became very popular at one time. They must be judged as among the more successful of the type, for the old C/96 'broomhandle' pistols had the bulk and weight to overcome, partially at least, some of the recoil forces while the box magazines in front of the trigger guard had the space potential to accommodate long magazines. But outside Germany and to a lesser extent Spain these Mauser machine pistols never caught on to any great extent in Europe. In the Far East, however, it was a different story. The Chinese took to the Mausers with a will and were soon turning out their own locally-produced copies that varied in materials and manufacturing standards from the excellent to the vile. The Chinese found the machine pistol to be just the sort of weapon that struck fear into an opponent, and the war lords who ruled in China between the world wars found them ideal for keeping their subjects under control. The Chinese even discovered the way to use the machine pistol's muzzle jump to good effect: they simply turned their Mausers onto one side as they fired so that, instead of spraying bullets at the sky, the machine pistol produced a wide fan of lethal projectiles that could cover a wide horizontal arc. This simple expedient has been little used elsewhere, but in the Far East this ploy was standard practice.

During World War II the machine pistol underwent a brief flurry of revival but the advantages of the sub-machine gun proved to be too many for the relatively expensive machine pistol, and few were made. From time to time interest was revived, but it was not until after World War II that service examples were seen in any numbers. These were intended for use by the crews of armoured or 'B' vehicles who did not normally require a rifle, or who did not have the space to carry one on their normal duties. For such personnel the machine pistol seemed attractive and thus the Czech Skorpion, the Polish wz 63 and the Soviet Stechkin came upon the scene. The Stechkin may be regarded as an update of the old Mauser pistols. It has even revived the practice of using a wooden holster that doubles as a butt stock, and it retains all the old problems of muzzle climb during burst fire. At least the Skorpion and the wz 63 have bulk and some degree of compensation built into their designs.

Above: The Heckler und Koch VP-70 is an ingenious modern attempt to produce a controllable machine pistol. Automatic fire is only possible when the holster/stock is fitted, allowing three-round bursts. The burst facility allows reasonable aimed automatic fire.

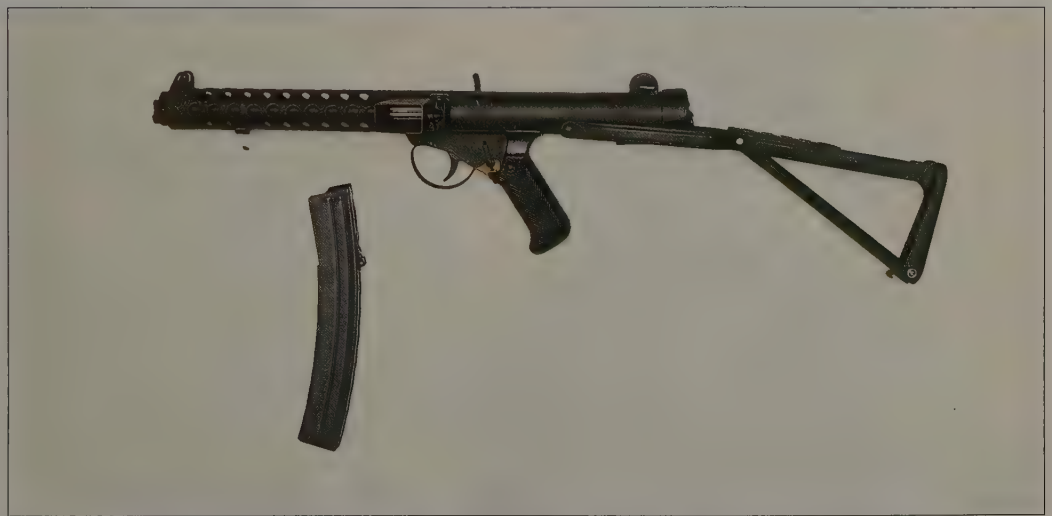
Below: To convert a blowback pistol to full automatic, all that is required is some means of interrupting the trigger mechanism. This home-made conversion of a Government Model Colt was captured from the IRA in Ulster. Note the extended magazine.



Despite the problems with the machine pistol listed above, it would be as well to list its advantages. The machine pistol can have a considerable shock effect in confined areas where any sudden spray of automatic fire will hit a target. Even the knowledge that a sudden burst of fire might be imminent can be enough for the owner of such a weapon to control local events, and it is this latter fact that makes the machine pistol attractive to many police and security forces. Even so, many sub-machine guns are now small and handy enough to rival the facilities of the machine pistol, the Mini-UZI and the Ingram designs being cases in point. But no doubt the machine pistol will continue to surface in the future.

The Sterling in all its forms has proved to be a very reliable and sturdy weapon. With many armies, including the British army, the weapon is used to arm second-line personnel who do not have to carry the normal service rifle and on vehicles it can easily be folded away to take up very little stowage space. With the British Army the L2A3 will gradually be replaced by the new 5.56-mm (0.219-in) Individual Weapon (IW) starting in the near future, but the large numbers of Sterlings still around the world mean that it will still be a widely used type for many years to come.

Specification
L2A3
Calibre: 9 mm (0.354 in) Parabellum
Weight: loaded 3.47 kg (7.65 lb)
Length: with stock extended 690 mm (27.16 in) and with stock folded 483 mm (19 in)
Length of barrel: 198 mm (7.8 in)
Muzzle velocity: 390 m (1,280 ft) per second
Cyclic rate of fire: 550 rpm
Magazine: 10- or 34-round



Replacing the ubiquitous Sten in British Army service, the Sterling L2A3 9-mm sub-machine gun has been sold in over 90 countries, and has proved effective and reliable under the most extreme of weather conditions, ranging from Arctic cold to jungle heat and humidity.

AUSTRALIA

9-mm F1

During World War II a Lieutenant Owen invented the sub-machine gun that still bears his name, and this weapon was used by Australian soldiers during World War II and for many years after it. One of the most recognizable features of the **Owen** sub-machine gun was the vertical magazine, a feature with no particular merit or demerit but one that the Australians found very much to their liking. Thus when the Australian army began searching for a new design to replace the old and worn Owens, it was not averse to choosing a design with an overhead vertical magazine.

Before selecting the design now known as the **F1**, the Australians investigated a number of experimental weapons that rejoiced in such names as 'Kokoda' and the 'MCEM'. Some of these experimental designs had some advanced features but were generally regarded as not being 'soldier-proof' enough to suit Australian conditions. But in 1962 a design known as the **X3** was selected for production, and this became the F1. The predilections of the Australian military were very evident, for the F1 has a vertical magazine but in order to allow a certain amount of interchangeability with other weapons the magazine is now curved and identical to that of the British Sterling and the Canadian C1.

This interchangeability factor is also evident in several other features of the F1. The pistol grip is the same as that used on the L1A1 7.62-mm (0.3-in) NATO rifle, and the bayonet is another Sterling component. In fact it is tempting to regard the F1 as an Australian Sterling but there are too many differences to support such a claim. The F1 uses a simple 'straight-through' design with the butt fixed in line with the tubular receiver, and the pistol group is arranged differently from that of the Sterling. The overhead magazine does produce one difficulty, namely sighting. In action deliberate aiming is not common but has to be taken into account, so a form of offset sighting system had to be introduced. On the F1 this is done simply by using an offset leaf sight (folding down onto the tubular receiver) allied with a fixed offset foresight. The F1 does have one rather unusual safety built into the design which is not common but yet is simple and effective: on a short-barrelled weapon it is often too easy to place the forward grip over the muzzle or too close to it for safety, but on the F1 a simple sling swivel bracket prevents the hand from getting too close to the muzzle.

The F1 has some other simple but effective design features. One is the cocking handle, which exactly duplicates the position and action of its counterpart on the L1A1 standard service rifle in use with the Australian forces; this handle has a cover which prevents dirt and debris getting into the action, though if enough dirt does get into the action to prevent the bolt closing the cocking handle can be latched to the bolt for the firer to force it closed in an emergency.

For all its many attributes the F1 has yet to be bought outside Australia and some of its associated territories. At one time there was talk of its being replaced by the American M16A1 rifle, but the F1 is still around and seems set for a long service career to come.

Specification
F1

Calibre: 9 mm (0.354 in) Parabellum
Weight: loaded 4.3 kg (9.48 lb) with bayonet
Length: 714 mm (28.1 in)
Length of barrel: 213 mm (8.386 in)
Muzzle velocity: 366 m (1,200 ft) per second
Cyclic rate of fire: 600-640 rpm
Magazine: 34-round curved box

Above: Replacing the extremely popular Owen sub-machine gun in Australian service, the F1 retains the uniquely Australian feature of a vertical top-loading magazine. The F1 is otherwise similar to the Sterling.

Below: Simple and effective, the F1 in its prototype X3 form performed extremely well in the Mekong Delta during the Vietnam War. Modern construction made it almost 1 kg (2.2-lb) lighter than its World War II ancestor.

SWEDEN

9-mm Model 45

The 9-mm **Model 45** was produced originally by the Karl Gustav Stads Gevärsfaktori (now part of the FFV consortium) at Eskilstuna, and is thus widely known as the Carl Gustav sub-machine gun. The Model 45 is an entirely orthodox design with no frills, and uses a simple tubular receiver and barrel cover with a simple folding butt hinged onto the pistol grip assembly. The usual blowback operating principle is employed, and overall there is nothing remarkable about the Model 45.

But there is one interesting point regarding the Model 45, and that is the magazine. On many sub-machine guns the magazine is usually one of the most trouble-prone components, for the magazine relies upon simple spring pressure to push the rounds towards the receiver, whence they are fed into the firing system. It is all too easy for rounds to become misaligned or forced together and the result is then a misfeed or jam, and these can happen at inopportune moments in combat. On the original Model 45 the magazine used was that once used on the pre-war Suomi Model 37-39, a 50-round magazine that was then considered to be one of the best in use anywhere. But in 1948 a new magazine was introduced that held 36 rounds in twin rows that were carefully tapered into a single row by the use of a wedge cross-section. This new magazine proved to be remarkably reliable and trouble-free in use, and was soon being widely copied elsewhere. Production Model 45s were soon being offered with a revised magazine housing to accommodate both the Suomi magazine and the new wedge-shaped magazine, and this version was known as the **Model 45/B**. Later production models made provision for the wedge-shaped magazine only.

The Model 45 and Model 45/B became one of Sweden's few major export weapons. Numbers were sold to Denmark and some other nations such as Eire. Egypt produced the Model 45/B as the **'Port Said'** under licence. Copies have also been produced in Indonesia. Perhaps the oddest service use of the Model 45/B was in Vietnam. Numbers of these weapons were obtained by the American CIA and converted in the United States to take a special barrel allied to a silencer. These were used in action in Vietnam by the US Special Forces on undercov-

The 9-mm Model 45 is generally known as the Carl Gustav, after its manufacturer. Conventional in design and operation, it has been in production since 1945 and has been exported widely.

er missions. According to most reports the silencers were not particularly effective and they were not retained in use for long.

Numerous accessories have been produced for the Model 45, one of the oddest being a special muzzle attachment that doubles as a blank firing device or a short-range target training device. The attachment is used together with special plastic bullets which are shredded into pieces as they leave the muzzle for safety. These bullets generate enough gas pressure to operate the mechanism and if required enough pressure is available to project a steel ball from the attachment itself. This reusable steel ball can thus be used for short-range target practice.

Specification
Model 45/B
Calibre: 9 mm (0.354 in) M39B Parabellum
Weight: loaded 4.2 kg (9.25 lb)
Length: with stock extended 808 mm (31.8 in) and with stock folded 551 mm (21.7 in)
Length of barrel: 213 mm (8.385 in)
Muzzle velocity: 365 m (1,198 ft) per second
Cyclic rate of fire: 550-600 rpm
Magazine: 36-round box

Used by many countries, including Egypt (in the 1967 war with Israel) and the USA (in a silenced version by special forces in Vietnam), the Carl Gustav remains in large-scale service with the Swedish forces.

FRANCE

9-mm MAT 49

Immediately after 1945 the French armed forces were armed with a variety of sub-machine guns, some of them dating from before the war and others were coming from the United States and the United Kingdom. While the weapons were serviceable enough, the range of ammunition calibres and types was considered to be too wide, and after a selection process it was decided to standardize on the 9-mm Parabellum round for future developments. A new sub-machine gun of French origins was requested, and three arsenals responded with new designs. That of the Manufacture d'Armes de Tulle (hence MAT) was selected, and the weapon went into production in 1949.

The **MAT 49** is still in widespread service, for it is a very well made weapon. Although it uses the now-commonplace method of fabricating parts and assemblies from stampings, those in the MAT 49 were made from heavy-duty steels and are thus very strong and capable of absorbing a great deal of hard use. The design uses the blowback principle but in place of what is now described as a 'wrap-around' breech block to reduce the length of the receiver the MAT 49 has an arrangement in which a sizable portion of the breech block enters the barrel chamber to have much the same effect. No other design uses this feature, and there is another aspect of the MAT 49 which is typically French. This is the magazine housing, which can be folded forward with the magazine inserted to reduce the bulk of the weapon for stowage and transport. This feature is a carry-over from the pre-war MAS 38, and was considered so effective by the French army that it was retained in the MAT 49: a catch is depressed and the magazine housing (with a loaded magazine in place) is folded forward to lie under the barrel, while to use the weapon again the magazine is simply pulled back into place so that the housing acts as a foregrip. This foregrip is made all the more important by the fact that the MAT 49 can be fired on automatic only, so a firm grip is needed to keep the weapon under control when fired.

Considerable pains are taken on the MAT 49 to keep out dust and dirt, which is another historical carry-over from previous times as the MAT 49 was intended for use in the deserts of North Africa. Even when the magazine is in the forward position a flap moves into position to keep out foreign matter. If repairs or cleaning are required the weapon can be easily stripped without tools. In action a grip safety locks both the trigger mechanism and any possible forward movement of the bolt.

Overall the MAT 49 is a sturdy and foolproof weapon. It is still used by the French armed forces and by various of the French police and paramilitary units. It has also been sold abroad to many of the ex-French colonies and wherever French interests prevail. There is a chance that the recent introduction of the 5.56-mm (0.219-in) FA MAS rifle to the French army may reduce the numbers in service, but there are enough operators left to ensure that the MAT 49 will remain around for a long time to come.

Specification
MAT 49
Calibre: 9 mm (0.354 in) Parabellum
Weight: loaded 4.17 kg (9.19 lb)
Length: with butt extended 720 mm (28.34 in) and with butt closed 460 mm (18.1 in)
Length of barrel: 228 mm (8.97 in)
Muzzle velocity: 390 m (1,280 ft) per second
Cyclic rate of fire: 600 rpm
Magazine: 20- or 32-round box

Above: Entering French service in 1949, the 9-mm MAT 49 is an extremely rugged design, made from heavy-gauge steel stampings. The pistol grip/magazine housing hinges forward for stowage and transport.

Right: Designed with colonial service in mind, the MAT 49 was used extensively in Indo-China, as well as with the paratroops so notably involved in the bloody conflict in Algeria. It stood such stern tests successfully.

WEST GERMANY

Heckler und Koch MP5

Since World War II the West German concern of Heckler und Koch has become one of Europe's largest and most important small-arms manufacturers with its success based soundly on the production of its G3 rifle, which has become a standard NATO weapon and is in use all over the world. Working from the G3 and employing its highly efficient breech-locking mechanism, the company has also produced the **Heckler und Koch MP5**, which may thus be regarded as the sub-machine gun version of the G3.

In appearance the MP5 looks very similar to the G3 although it is of course much shorter. It fires the usual 9-mm (0.354-in) × 19 Parabellum cartridge, and although this is relatively low-powered compared with the 7.62-mm (0.3-in) rifle cartridge the MP5 uses the same roller and inclined ramp locking mechanism as the G3. The complexity of this system is more than offset by its increased safety, and by the ability of the MP5 to be fired very accurately as it can fire from a closed bolt, i.e. the breech block is in the forward position when the trigger is pulled so there is no forward-moving mass to disturb the aim as there is with other sub-machine guns. The resemblance to the G3 is maintained by the use of many G3 components on the MP5.

There are six main versions of the MP5. The **MP5A2** has a fixed butt stock while the **MP5A3** has a metal strut stock that can be slid forward to reduce its length. There are no fewer than three differing versions of the **MP5 SD**, which is a silenced version of the basic model for use in special or anti-terrorist warfare. The **MP5 SD1** does not have a butt stock at all; the **MP5 SD2** has a fixed butt as on the MP5A2; and the **MP5 SD3** has the sliding metal butt stock used on the MP5A3. Then there is the **MP5K** which is a very short version of the basic MP5, only 325 mm (12.8 in) long and recognizable by a small foregrip under the almost non-existent muzzle. The **MP5K A1** is a special version of this variant with no protrusions so that it can be carried under clothing or in a special holster.

In all its forms the MP5 has proved to be an excellent and reliable sub-machine gun. It is in use with some of the various West German police agencies and border guards, and numbers have been purchased by Swiss police and the Netherlands armed forces. It is known to be one of the weapons most favoured by the British SAS for close-quarter combat.

Unfortunately some MP5s have fallen into the wrong hands, usually by theft from weapon stores. The MP5 was the main weapon of the Baader-Meinhoff gang and many similar groups are known to have used the MP5 at one time or another. The MP5 has been described by one counter-insurgency authority as 'the most efficient terrorist weapon now in production', and it will no doubt feature in many future terrorist or 'freedom fighter' outrages. This future use might well involve various forms of night sight, for the MP5 has been demonstrated on numerous occasions with such devices, along with other sighting devices such as telescopic sights and other rapid-aiming systems.

Top: The MP5A3 is fitted with a sliding metal strut stock which can allow a considerable reduction in overall length, from 660 mm (26 in) to 490 mm (19.3 in).

Above: The MP5A2 is fitted with fixed plastic butt stock. After 1978 the MP5 was fitted with a curved magazine to improve cartridge feed.

Below: The MP5SD3 is a silenced version of the MP5A3, all parts except barrel and silencer being the same. It is used by several military and police forces around the world.

Right: The extremely short MP5K was introduced for use by special police and anti-terrorist squads, where weapon concealment may be essential.

Specification

MP5A2

Calibre: 9 mm (0.354 in) Parabellum
Weight: loaded 2.97 kg (6.55 lb)
Length: 680 mm (26.77 in)
Length of barrel: 225 mm (8.86 in)
Muzzle velocity: 330 m (1,083 ft) per second
Cyclic rate of fire: 800 rpm
Magazine: 15- or 30-round box

Embassy Siege!

The dazzling operation to free the Iranian embassy hostages in 1980 provided more publicity than the SAS would have wished. Foremost in the public mind were the questions, 'Where did they come from?' and 'What did they do in there?'

Even though the Special Air Service performed brilliantly during World War II, it was disbanded subsequently, together with all other special force units. This was largely because official thinking held that the SAS role could be undertaken by units detached from, say, the Paras or Royal Marines; an inherent dislike for 'private armies'; and an overall financial cutback.

The Malayan Emergency demonstrated, however, that there were certain vital roles that only an SAS-type unit could perform, and that these roles demanded a very special type of soldier who could individually be found throughout the entire British army, but was not concentrated to any great extent in any one regiment. The SAS was thus re-formed, with a similar role to that undertaken in World War II: long-range reconnaissance, sabotage and general mayhem undertaken by basic four-man patrols. And although they were now fighting a counter-insurgency war, with all the obvious differences between that and conventional war, it was still a far cry from becoming actively involved in counter revolutionary warfare (CRW), let alone becoming the leading practitioners of its art. How the SAS achieved this role owes as much to the regiment's own initiative as it does to the demands of a drastically changing world.

The years between the end of the Malayan Emergency (1960) and the start of the Radfan campaign (1964) were relatively quiet for the SAS. Ever mindful of the need to keep their soldiers active in some way (not to mention the requirements of Whitehall and army politics), the SAS offered themselves as 'bodyguard' trainers: people whom the government of the day could loan to friendly (generally third world) governments to train their own personal protection squads. Needless to say, in most instances the offer was gratefully accepted; and as well as teaching, the SAS also learned a great deal, including the basic techniques for breaking out hostages held by a small group of fanatics.

Simultaneously, another team is abseiling from the roof of the building at the rear, armed with smoke, flash and concussion grenades. The two teams are in the embassy within seconds of each other.

The shooting dead of the Embassy Press Officer is a signal that time is running out for the other hostages, and the siege must be broken within minutes if more innocent lives are not to be lost. The SAS CRW (Counter-Revolutionary Warfare) troop are given the go-ahead from the highest authority.

From adjoining balconies, four black-clad figures move onto the embassy, placing explosives against the windows. Within seconds, an explosion is heard, and the SAS team is in the building.

Embassy Siege!

The SAS made use of these techniques on its own account during undercover operations in Aden, but the real switch from counter-insurgency to counter-revolutionary warfare occurred in 1972, the year of the Munich Olympics and the massacre of the Israeli athletes. Operational postmortems established that the German security forces had made mistakes, but that no blame could be attached because they were not trained to deal with totally ruthless, dedicated fanatics, well trained in all the terrorist arts. Putting regular police or military units against this type of enemy is rather like expecting a 'Sunday only' driver to do well at the Monaco Grand Prix. The German response was to set up GS G9; the British response was to enlarge the role of the SAS to counter the CRW threat, but still concentrating on basic 'extraction' techniques. Finally, the Mogadishu hijack brought home to politicians that the CRW threat could be countered effectively only by having in reserve a unit that was more effective and possibly even more ruthless than the terrorists themselves. It was not a new concept: the Israelis had been saying the same thing for years and moreover had proved it to be true.

Accordingly, the SAS established a troop (codenamed 'Pagoda' after the abseiling tower in Hereford) devoted to CRW. A Close Quarter Battle house was also built, and here the troop was trained to enter a room and put two bullets into every terrorist within seconds, carefully avoiding shooting any hostages. This led to choice of weaponry. The SAS is allowed to choose its own weapons; field trials narrowed the choice of sub-machine guns to two: the 9-mm Ingram MAC 11 and the 9-mm Heckler und Koch HK MP5. Both have a nearly identical magazine capacity (32 for the MAC 11 and 30 for the MP5). But the MP5 proved more robust, and a burst fired from the MAC 11 tends to spray, increasing the chances of hitting a non-combatant. There was a further consideration, namely ricochets: there is no point in hitting a terrorist with a bullet if that bullet can exit to ricochet off a wall and kill or maim a hostage or even one's own troops. The need is for an SMG that can accurately fire a low-velocity bullet (soft-nosed for stopping power), and for this the HP5 proved ideal. Affectionately known as 'Hochlers' the SAS MP5s now boast a curved magazine designed to take the special bullets without jamming.

Inside the building, the shock tactics and weapons used by the CRW teams have stunned both hostages and terrorists. The SAS troopers shoot first, rather than ask questions, as the raised hand of a terrorist is equally likely to hold a grenade as to be surrendering.

Armed with 13-shot Browning High Power pistols and 'Hochlers' (H&K MP5 sub-machine guns) and trained to pick out targets in smoke-filled rooms and to shoot with hair's-breadth accuracy, the SAS troopers are more than a match for the terrorists. Within seconds, four are down and the hostages are being bundled out of the building at bewildering speed.

BBC sound man Harris, escaping through the first-floor windows of the embassy, is ordered across the balcony by the menacing figure of an SAS trooper and brusquely ordered to lie down.

The SAS achievement was not luck, but a product of extremely arduous training and painstaking preparations from the moment the siege was announced. The team, familiar with the building from plans and surveillance, trained to act with the utmost speed and, where necessary, ruthlessness, made their plan and carried it out with a professionalism few in the world could match.

Heckler und Koch MP5

The SAS is allowed to choose its own weapons, and after extensive trials decided to adopt the German Heckler und Koch MP5. Robust and reliable, the 'Hochlers', as they were soon dubbed, fire the relatively low-powered 9-mm (0.354-in) × 19 Parabellum cartridge, which reduces the danger of ricochet in house-to-house fighting. By firing from the closed bolt position, the MP5 achieves greater accuracy than most other sub-machine guns, there being no forward-moving mass to disturb the aim.

That the seizure of the Iranian embassy in London during 1980 was inspired by the Iraqi government in order to embarrass Tehran is beyond a shadow of doubt. What is forgotten is that the terrorists were told that London had been chosen as a target because, amongst other considerations, the London police are very kind and will not kill you. (It does seem that the image of the friendly British 'bobby' attracts all sorts of tourists to these shores!) But while such a comment shows a certain amount of cynicism on the part of the man who made it (as well as a degree of naivety on the part of the men who believed it), it also indicates that terrorists usually operate only where they think they can get away with it: there is reduced value in mounting an operation where all of the objectives are achieved and most of the participants are killed. Aside from anything else, it makes recruiting that much harder. However, this was to be the first time that the SAS CRW 'Pagoda' troop would be seen in action in its own country. But it was not just the SAS: for both political and operational reasons, the SAS cannot be seen to be the sole counter force available. First, the maintenance of the rule of law is and must remain the responsibility of the police; second, there is an obvious manpower problem; and third, 'private armies' are still unpopular with large sections of the public, even though the SAS is by no stretch of the imagination 'private'.

Embassy siege operational timetable

Day 1 (Wednesday 30 April)

11.32: Iranian Embassy seized by Moslem terrorist group.

15.00: SAS advance team on site. Though used as a last-resort force, the SAS is not called in at the last minute, but was (and still is) used in assessing the threat and planning countermeasures from the outset.

Day 2 (Thursday 1 May)

10.00: An official denial of SAS involvement is issued. This is not so much to mislead the public as to mislead the terrorists; while some terrorists may surrender the moment they know that the SAS is involved, others are just as likely to panic and kill everyone they can. From this day on, extensive monitoring and surveillance, using the latest electronic techniques, is started. Luckily, one of the houses next to the embassy is vacant, and from here two types of probes are inserted through the walls, under the direction of Scotland Yard's C7, which has operational control of the latest high-technology surveillance devices. The first type of probe is a simple microphone, the second a more elaborate 'borescope'. This latter is a British invention, developed by Keymed Industrial, and uses fibre optics to 'see' through walls and other solid objects. Originally developed for medical and industrial purposes, its value in CRW (and indeed in general crime prevention) soon became obvious. First, a tiny hole is bored through a wall; then a fibre optical lense is inserted to provide (either on a TV monitor or direct to the naked eye) wide angle or close-up pictures of the next door room. The borescope

can also be used to look inside suspect letters, parcels and even petrol tanks; in this instance it establishes where the hostages are being kept and provides visual identification of the terrorists themselves, and the weapons they are using.

Day 3 to 5 (Friday 2 May to Sunday 4 May)

Negotiations continue with the terrorists. The SAS refines its battle plan. Towards the end of this period, outside noise (low-flying aircraft, road drills etc.) are brought into use: the reasoning is that if the SAS does go in, it will be under cover of such noises, and that it is better to get the terrorists used to them now.

Day 6 (Monday 5 May)

Negotiations have broken down. Surveillance indicates that the terrorists are likely to start shooting their hostages, as indeed they do. The decision is taken that while the death of one hostage (non-British) can be tolerated, the threat or implementation of any more murders will mean an SAS attack. In particular, the SAS must clear and secure the first floor.

19.23: At the front of the building, a four-man team blows out the armour-plated windows, throws in stun grenades and enters the room. Moving past one of the hostages taking cover on the floor, the team finds PC Trevor Lock (a hostage from the beginning) grappling on the ground with one of the terrorists. One SAS soldier shoots the gunman, and PC Lock tells him that there are now six terrorists left in the building. 'Room clear. PC confirms six terrorists,' shouts the SAS soldier to his mates, and this information is quickly relayed to all other members of the attack force. An assault is ordered on the ambassador's office; an armed terrorist is driven back inside the office by a controlled burst from an HP5; three soldiers following up discover him lying on a sofa, pointing a gun in their direction; three more bursts and he is dead, spare ammunition falling from his hand in his death throes. Meanwhile, another assault group has abseiled down the rear of the building. One of this group is left dangling as his equipment jams: he orders the men still on the roof to cut the rope, and lands on a second-floor balcony. Bursting through the window, he makes his way through the telex room (where he notices the body of another terrorist). A group of hostages and two men separate form the hostages are huddled together on the floor. He asks them who they are in Arabic, and they reply that they are students. Calling for assistance, he orders them searched. The search reveals a hidden revolver and ammunition, and the terrorist with the revolver snatches his hands to the centre of his body – he could, probably is, going for a grenade, but a burst from an HP5 silences him forever. The hostages are now taken rather than led to safety as there is no way of knowing if a terrorist is hiding amongst them. They are literally thrown from SAS soldier to SAS soldier down the stairs and, their hands quickly secured, laid down in the back garden until they can be identified and until all the terrorists are discovered.

19.40: Within 17 minutes, all the hostages have been identified. All the terrorists have been killed, except one who disguised himself as a hostage and made no threatening move when he was discovered.

The lesson

Should you ever decide to take over an embassy and the SAS comes storming in, do not fight back. Get rid of as many clothes as you can to show you are not carrying a concealed weapon. If possible, tie your own hands behind your back, and lie on the floor and keep very, very still. You just might get out alive, which is more than did the murdered hostages at the Iranian embassy, or the Munich athletes, or the women and children at Lod airport.

Better still, decide to make your protest some other way, because unless you are very lucky and incredibly skilled, when the SAS (or GS G9, or Delta Force, or if you are in the USSR the Spetsnaz) troops come storming in, you will only have about four minutes to write your will and wonder if maybe you made a mistake.

Walther MP-K and MP-L

[illegible]

Specification
MP-K
Calibre [illegible]
Weight [illegible]
Length [illegible]
Length of barrel [illegible]
Muzzle velocity [illegible]
Cyclic rate of fire [illegible]
Magazine [illegible]

Specification
MP-L
Calibre [illegible]
Weight [illegible]
Length [illegible]
Length of barrel [illegible]
Muzzle velocity [illegible]
Cyclic rate of fire [illegible]
Magazine [illegible]

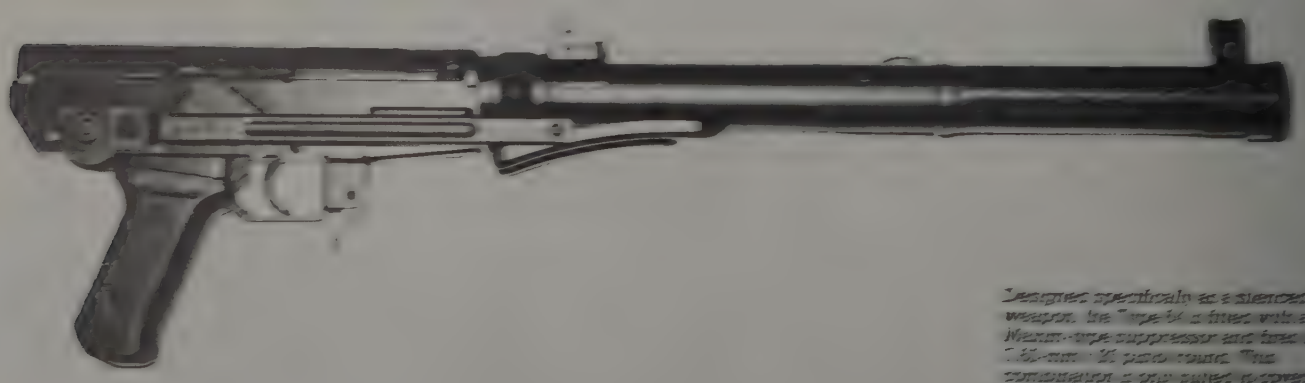
7.62-mm Type 64

The Type 64 is a mixture of various design features [illegible]

The Type 64 uses a selective fire trigger mechanism derived from that of the Bren gun and a bolt action taken from the Type 41 - the Chinese copy of the Soviet PPS-41.

[illegible]

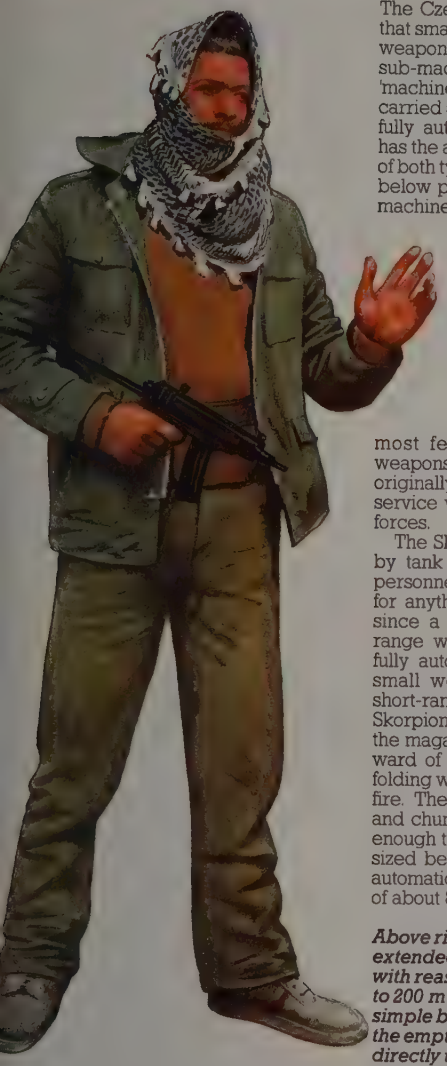
Specification
Type 64
Calibre [illegible]
Weight [illegible]
Length [illegible]
Length of barrel [illegible]
Muzzle velocity [illegible]
Cyclic rate of fire [illegible]
Magazine [illegible]



Designed specifically as a silenced weapon, the Type 64 is fitted with a Maxim-type suppressor and fires the 7.62-mm × 25 pistol round. This combination is only suited to covert operations, being of doubtful value in sustained action.

CZECHOSLOVAKIA

Model 61 Skorpion



The Model 61 Skorpion is a favourite weapon of the Palestine Liberation Organization, its small size making for easy concealment.

The Czech **Model 61 Skorpion** lies in that small-arms no-man's-land where a weapon that is neither a pistol or a true sub-machine gun is described as a 'machine pistol': it is small enough to be carried and fired as a pistol, but it fires fully automatically when required. It has the advantages and disadvantages of both types of weapon and is perhaps below par as both a pistol and a sub-machine gun, but it is now one of the most feared of all 'underground' weapons, despite the fact that it was originally intended to be a standard service weapon for the Czech armed forces.

The Skorpion was designed for use by tank crews, signallers and other personnel who have no normal need for anything larger than a pistol. But since a pistol is essentially a short-range weapon, the introduction of a fully automatic feature provided this small weapon with a considerable short-range firepower potential. The Skorpion resembles a pistol, though the magazine is not in the butt but forward of the trigger assembly, and a folding wire butt is provided for aimed fire. The overall appearance is short and chunky, and the weapon is small enough to be carried in a rather oversized belt holster. When fired on full automatic the weapon has a cyclic rate of about 840 rounds per minute, which makes it a formidable weapon at short ranges, but this benefit is offset by two considerations. One is that using any machine pistol on full automatic makes the weapon almost impossible to aim accurately: the muzzle forces cause the muzzle to climb and judder to such an extent that it is virtually impossible to hold the weapon still for more than an instant. The other consideration is that the Skorpion uses magazines with only 10- or 20-round capacity, and on automatic either would soon be exhausted. But while the Skorpion fires it sprays bullets in an alarming swathe and this makes it a formidable close-quarter weapon.

The Skorpion operates on the blowback principle. Single shots can be selected, and aiming is assisted by use of the folding wire butt. The basic Model 61 Skorpion fires the American 0.32-in (actual 7.65-mm) cartridge, making it the only Warsaw Pact weapon to use this round, but the **Model 63** uses the 9-mm short (0.38-in) round and the **Model 68** the 9-mm (0.354-in) Parabellum. A silenced version of the Model 61 is available.

Apart from the Czech armed forces, the Skorpion has also been sold to some African nations, but its main impact has been in the hands of guerrillas and 'freedom fighters'. The firepower impact of the Skorpion is considerable at short ranges, which suits the requirements of assassination and terror squads, so the type is now much favoured by such groups. With them it has turned up in many parts of the world from Central America to the Middle East.

Above right: Stock fully extended, the Type 61 can shoot with reasonable accuracy at up to 200 m (220 yards). It uses a simple blowback operation, but the empty case is ejected directly upwards.

Specification
Model 61 Skorpion
Calibre: 0.32 in (actual 7.65 mm)
Weight: loaded 2 kg (4.4 lb)
Length: with butt extended 513 mm (20.2 in) and with butt folded 269 mm (10.6 in)
Length of barrel: 112 mm (4.4 in)
Muzzle velocity: 317 m (1,040 ft) per second
Cyclic rate of fire: 840 rpm
Magazine: 10- or 20-round box

POLAND

9-mm wz 63 (PM-63)

The 9-mm **wz 63** (*wzor*, or model) is also known as the **PM-63**, and is one of those weapons that falls into the category of machine pistol. Although only slightly larger than an orthodox pistol, it can be fired fully automatic at a cyclic rate of 600 rounds per minute. It was designed by Piotr Wilniewicz, who led a design team to produce a weapon for those elements of the Polish forces who are unable to carry a conventional weapon during their combat duties. The wz 63 is thus used by Polish tank crews, signallers and other troops such as truck drivers.

The wz 63 is rather long for a conventional pistol and is fitted with a butt that can be folded forward to lie under the barrel. When folded forward the butt either lies under the forward grip, or the butt plate can be folded down to act as a forward grip. This forward grip is essential to hold the weapon steady on automatic fire, for the wz 63 suffers from the usual difficulty of rapid and erratic muzzle movement mainly caused by the cyclic rate of fire. Some of this muzzle movement is compensated by a simple fixture on the end of the barrel which is little more than an open trough angled upwards at a slight angle to push the barrel downwards. In practice this device appears to be of marginal value. Accurate single-shot aiming is possible, but even when using the butt any deliberate aim is likely to be disturbed by the bolt moving forward as the trigger is pulled since, like most other blowback-operated weapons, the wz 63 operates from an open bolt. However its effective range using the stock extended into the shoulder is stated to be 200 m (219 yards); on automatic the range is much less.

The wz 63 may be used with either a 25- or a 40-round magazine, although some references also mention a 15-

Although classed as a machine pistol, the wz 63 is more complex than the Skorpion and it would require a firm hand indeed to fire 9-mm×18 cartridges on full automatic. It is perhaps no accident that the handbook only shows it deployed for two-handed use.

round magazine. It is normally issued together with a special holster and a pouch holding three magazines and a cleaning kit. A sling may also be supplied.

The round fired by the wz 63 is the 9-mm (0.354-in) × 18 Makarov cartridge, which differs in several ways from the usual 9-mm (0.354-in) × 19 Parabellum round. It provides the wz 63 with a considerable striking capability at short combat ranges but as stated before the ability of any machine pistol to remain on target for more than a fleeting second is unlikely. Instead the wz 63 produces a 'spray' effect which can be of considerable value in combat, but even this effect is reduced by the magazine capacity.

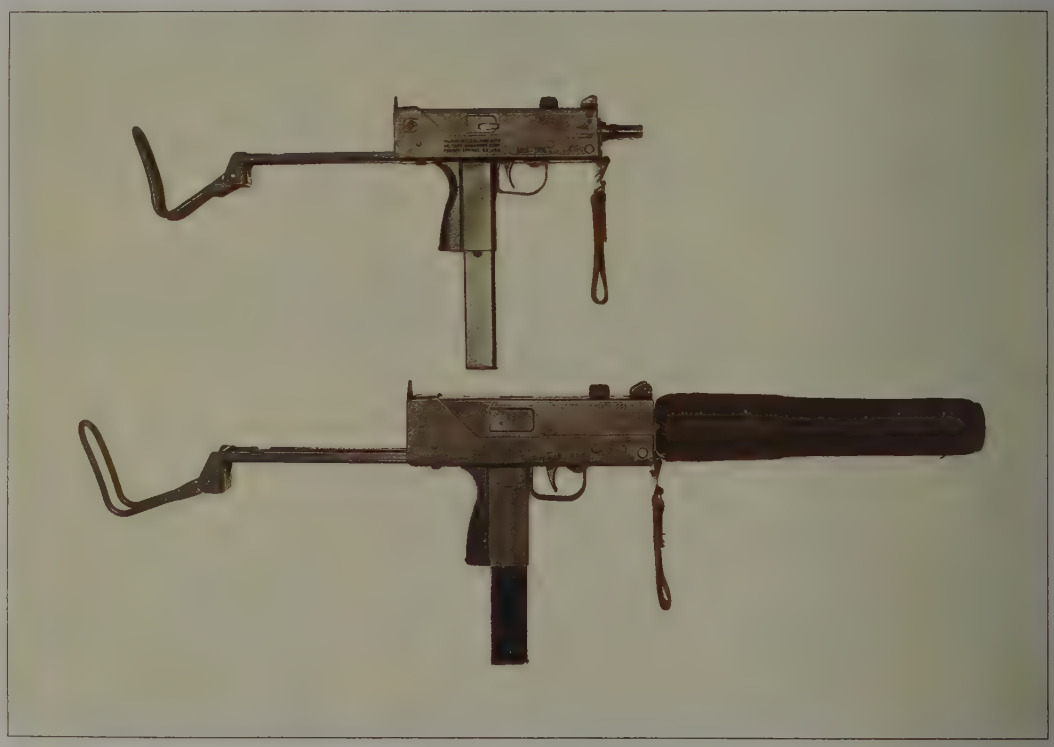
The wz 63 is still used by the Polish troops for which it was designed, and the type is now extensively used by Polish police and security units. Outside Poland the wz 63 appears to be little used, though numbers of these weapons have turned up in the Middle East and have been observed by several of the organizations involved in the civil war in Lebanon.

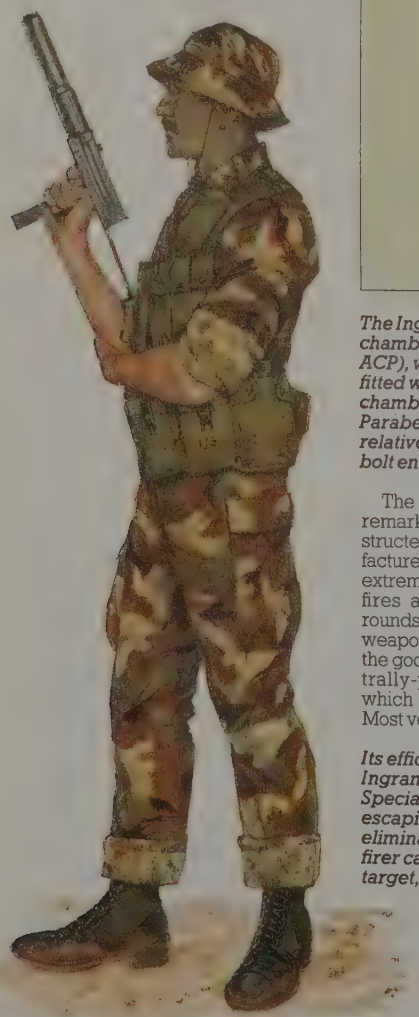
Specification
wz 63
Calibre: 9 mm (0.354 in) Makarov
Weight: with empty 32-round magazine 1.8 kg (3.97 lb)
Length: with stock retracted 333 mm (13.1 in)
Length of barrel: 152 mm (6 in)
Muzzle velocity: 323 m (1,060 ft) per second
Cyclic rate of fire: 600 rpm
Magazine: 25- or 40-round box; also references to 15-round box

USA

Ingram Model 10

There have been few weapons in recent years that have 'enjoyed' the attentions of the Press and Hollywood to such an extent as that lavished on the Ingram sub-machine guns. Gordon B. Ingram had designed a whole string of sub-machine guns before he produced his **Ingram Model 10**, which was originally intended to be used with the Sionics Company suppressor. First produced during the mid-1960s, the little Ingram Model 10 soon attracted a great deal of public attention because of its rate of fire, supposedly high enough to 'saw a body in half', coupled with the highly efficient sound suppressor. Hollywood and television films added their dramatic commentaries and the Ingram Model 10 soon became as widely known as the old Thompson sub-machine guns of the 1920s.





The Ingram Model 11 (top) is chambered for 9-mm Short (.380 ACP), while the Model 10 (below), fitted with a suppressor, can be chambered for either 9-mm Parabellum or .45 ACP. Both are relatively well balanced due to the bolt enveloping the breech.

The Ingram Model 10 is indeed a remarkable little weapon. It is constructed from sheet metal but manufactured to a very high standard and extremely robust. This has to be, for it fires at a cyclic rate of over 1,000 rounds per minute, yet control of the weapon is still relatively easy thanks to the good balance imparted by the centrally-placed pistol group through which the box magazine is inserted. Most versions have a folding metal butt but this may be removed, and many weapons not fitted with the long tubular suppressor use a forward webbing hand-strap as a rudimentary foregrip. The muzzle on most models is threaded to accommodate the suppressor, and when fitted this is covered with a heat-resistant canvas or plastic webbing to allow it to be used as a forward grip. The cocking handle is on top of the slab-sided receiver and when turned through 90° acts as a safety lock. As this handle is slotted for sighting purposes the firer can soon notice if this safety is applied, and there is a normal trigger safety as well.

Its efficient suppressor makes the Ingram a handy weapon for the Special Forces. By reducing the escaping gas to subsonic speed and eliminating flash, the position of the firer can remain a mystery to the target, until hopefully it is too late.

The Model 10 may be encountered chambered for either the well-known 11.43-mm (0.45-in) cartridge or the more usual 9-mm (0.354-in) Parabellum. The latter round may also be used on the smaller **Model 11** which is normally chambered for the less powerful 9-mm Short (.380 ACP). In all these calibres the Ingram is a dreadfully efficient weapon and not surprisingly it has been sold widely to customers ranging from paramilitary forces to bodyguard and security agencies. Military sales on any large scale have been few but several nations have acquired numbers for 'testing and evaluation'. The British SAS is known to have obtained a small quantity for testing. Sales have not been encouraged by the fact that the ownership and manufacturing rights have changed hands several times, but both the Model 10 and Model 11 are now back in production and selling well. In order to keep sales rolling several variants have been made. Versions firing single-shot only and without the folding butt are available, and at one point a long-barrelled version was produced, though only in limited numbers as the type did not find a ready market.

In the meantime Ingrams will be found in countries as diverse as Yugoslavia, Israel and Argentina. Many have been sold to the Central and South American nations.

Specification
Model 10 (0.45-in model)
Calibre: 11.43 mm (0.45 in)
Weight: loaded with 30-round magazine 3.818 kg (8.4 lb)
Length: with stock extended 548 mm (21.575 in) and with stock folded 269 mm (10.59 in)
Length of barrel: 146 mm (5.75 in)
Length of suppressor: 291 mm (11.46 in)
Muzzle velocity: 280 m (918 ft) per second
Cyclic rate of fire: 1,145 rpm
Magazine: 30-round box

ISRAEL

9-mm UZI

Once Israel had fought its War of Independence in 1948 the new nation had some breathing space in which to arm itself for any future conflict. Sub-machine guns were high on the list of priorities, for the new Israeli army was then equipped with all manner of old weapons varying from Sten guns to Czech weapons. The Czech weapons attracted the close attention of one Lieutenant Uziel Gail, for they had the advantage that their breech blocks or bolts were 'wrapped around' the barrel, so placing the mass of the bolt well forward around the barrel on firing and allowing a short weapon to have a relatively long barrel. The Czech weapons concerned were of the vz 23 series, and using these Gail was able to design and develop his own design that was more suitable to the manufacturing methods then available in relatively undeveloped Israel. He came up with a weapon that is now universally known as the **UZI** after its designer.

The UZI is made largely from simple pressings held in place by spot welds or other welding. The main body is made from a single sheet of heavy gauge sheet steel with grooves pressed into the sides to take any dust, dirt or sand that might get into the works. This simple feature makes the UZI capable of operation under even the most arduous conditions, a fact that has been proved on many occasions. The overall cross-section of the main body is rectangular with the barrel secured to the body by a large nut just behind the muzzle. The trigger group is situated centrally, and the box magazine is inserted through the pistol grip, which makes reloading very easy in the dark for 'hand will naturally find hand'. The normal combat magazine holds 32 rounds, but a common practice is to join two magazines together using a cross-over clip or even tape to allow rapid changing. A grip safety is incorporated into the pistol grip.

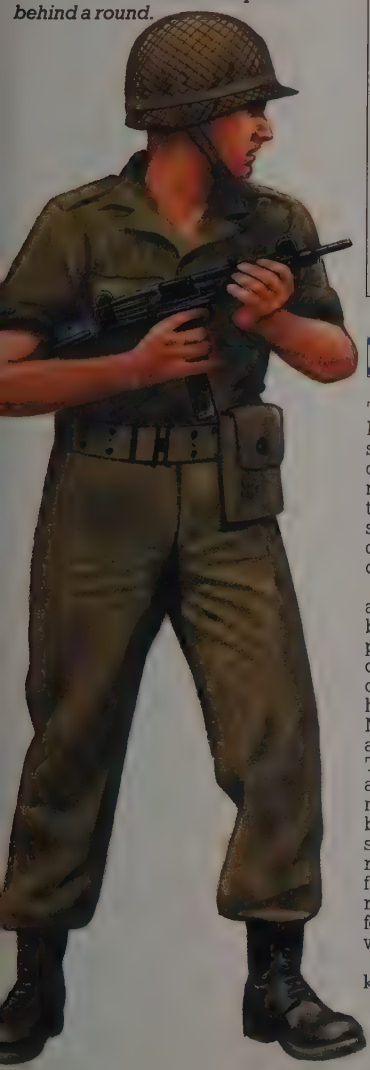
The UZI is now virtually one of the symbols of Israeli military prowess, but Israel is not the only nation to use the type. The West Germans also use the UZI, which they know as the **MP2**; this model was produced under licence by FN in Belgium. Numerous other nations also use the UZI. It is part of legend that the President of the United States is always accompanied by bodyguards carrying UZIs in specially fitted brief cases, and many other security agencies and police forces use the UZI.

The UZI may be encountered with either a sturdy fixed wooden butt stock or a metal stock that can be folded forward under the main body with the butt plate still available to assist in steadying automatic fire. The UZI can be used to fire single-shot by use of a change lever just above the pistol butt.

Specification
UZI (with wooden stock)
Calibre: 9 mm (0.354 in) Parabellum
Weight: loaded with 32-round magazine 4.1 kg (9 lb)
Length: 650 mm (25.59 in)
Length of barrel: 260 mm (10.24 in)
Muzzle velocity: 400 m (1,312 ft) per second
Cyclic rate of fire: 600 rpm
Magazine: 25- or 32-round box

Right: The UZI (with wooden stock) and the Mini-UZI. The Mini-UZI is just 36-cm (14-in) long with its stock folded, making for easy concealment under ordinary clothing. The UZI is a design of great simplicity and is famous for reliability in awkward conditions.

Below: This Israeli carries the UZI fitted with metal folding stock. In addition to a grip safety, the UZI features a ratchet on the cocking handle to prevent accidental firing if the user's hand slips off the handle after the breech block has passed behind a round.



ISRAEL

9-mm Mini-UZI

The **Mini-UZI** has been developed by Israel Military Industries from the full-scale UZI and differs from the original only in dimensions and weights. A few modifications have been introduced to the basic design, but these are only superficial while the operating system of the original has been retained unchanged.

The Mini-UZI has been developed as a weapon suitable for concealment by police and security personnel. This prompted an overall decrease in dimensions, and to improve this concealment a smaller 20-round magazine has been introduced, although the Mini-UZI can still use the existing 25- and 32-round magazines if required. The UZI parentage is immediately apparent but one change that can be noted is that the normal folding metal butt has been replaced by a single-strut butt stock that folds along the right-hand side of the body. When folded the butt plate acts as a rudimentary foregrip, but the normal foregrip is a plastic section just forward of the trigger group.

To date the Mini-UZI has been marketed as suitable for police and security agencies but it is bound to attract the attentions of various military organizations for special missions. It would make an ideal commando-type weapon where light weight is required, and it must be stressed that although the Mini-UZI is a scaled-down version of the original it still uses the potent 9-mm (0.354-in) × 19 Parabellum round. As the weapon is lighter than the full-size version its breech block is lighter too, and this provides a cyclic rate of fire of 950 rounds per minute, which is much higher than on the original.

The Mini-UZI is being marketed in the United States carried in a specially-fitted brief case together with spare magazines and a small cleaning and spares kit. It has already been suggested that some form of silencer could be fitted to the muzzle.

There are also some UZIs other than the standard version and the Mini-UZI. One is the semi-automatic **Carbine UZI** which has been produced to conform with the legal requirements of some American states that require non-automatic weapons only to be held by their inhabitants. In order to prevent the rapid conversion of semi-automatic versions of automatic weapons they call for such semi-automatic versions to have barrels at least 406 mm (16 in) long. Thus the standard UZI may be seen with a long barrel protruding from the body and this denotes that the weapon can be fired single-shot only.

Another UZI variant that has only recently been introduced is the UZI pistol. Although really outside the scope of this survey it is still recognizable as an UZI. It can be fired single-shot only and there is no form of butt stock.

Specification
UZI
Calibre: 9 mm (0.354 in) Parabellum
Weight: loaded with 20-round magazine 3.11 kg (6.85 lb)
Length: with stock extended 600 mm (23.62 in) and with stock folded 360 mm (14.17 in)
Length of barrel: 197 mm (7.75 in)
Muzzle velocity: 352 m (1.15 ft) per second
Cyclic rate of fire: 950 rpm
Magazine: 20-, 25- or 32-round box

The UZI in Action

The UZI has proved to be one of the most successful of all the post-war sub-machine gun designs, and it has shown its combat worth on many occasions. It will remain in use for many years to come and is still in production today.

Seen here in South African service, the UZI is one of the most widely used sub-machine guns in the world. With stock extended and in careful hands, the UZI will shoot with reasonable accuracy up to 200 m (220 yards), although it gained its reputation at much closer ranges.

The UZI sub-machine gun was conceived at a time when the new state of Israel had only just come into being. Almost as soon as Israel declared itself to be a state it was involved in a state of war that continues to the present day. In 1948 the neighbouring Arab nations attempted to crush Israel but failed, mainly as a result of the Israelis' determination to exist as a nation, and when the United Nations were at last able to impose a ceasefire the Israelis had established themselves by the simple process of defeating every one of their Arab foes.

All through the fighting of 1948 and 1949 the newly-formed Israeli army was armed with a hotchpotch of weapons. Sub-machine guns included old ex-German weapons and numbers of Sten guns, the latter being the usual weapon of the front-line troops. The Stens worked but were not regarded as being particularly reliable, and a replacement was thus sought. For supply safety it was considered suitable for the replacement to be manufactured locally, but at that time manufacturing facilities in Israel were few so the design had to be easy to make in quantity.

Several designs were put forward at the time. Most of them were 'paper' designs, but that of Lieutenant Uziel Gail was chosen. He had formed his design after careful examination of some Czech designs, notably the vzor (model) 23, 24, 25 and 26. These models were all basically the same, differing only in having a fixed or folding butt or the calibre used, but they all had the same basic mechanism and design feature: the use of a breech block, or bolt, that extended forward around the barrel. This had two main attractions: that at the instant of firing the mass of the bolt was well forward to ensure a good 'lock', and that as the bolt extended forward the barrel could be placed farther to the rear of the receiver or body to allow a short and handy weapon. Gail had no doubt obtained his study examples from the fighting during the War of Independence, and as at one point Czechoslovakia was happy to provide weapons to the new state, it is possible that the weapons came via a direct route. In any case Gail adopted the 'wrap-around' bolt to so pronounced a degree that his design was very much shorter than any contemporary equivalent. Gail also adopted the method of inserting the magazine through the pistol grip which not only provided a good balance for the weapon but it also made rapid insertion of a magazine easy using the principle that 'hand finds hand'. The folding metal butt was also taken from the Czech design.

But Gail was no mere plagiarist. He introduced his own ideas, not the least of which was ease of manufacture. The Sten gun and the German MP 38 of World War II had demonstrated that sub-machine guns could be manufactured easily using simple metal stampings and virtually no machining, and Gail simply took this method one stage further: almost the entire body of his design was made from a single sheet steel stamping that was then bent into shape to form a robust body. But Gail went one better. He was aware that much of the terrain over which the resultant weapon was to be used was dusty and arduous to a degree. Any weapon would have to operate with the virtual certainty that dust, dirt and sand would get into the works, so Gail designed two grooves into the initial stamping that could gather up all the debris inside the body and keep it out of the way. Thus the bolt could operate without the friction caused by sand and dirt, and indeed Gail's design can keep working when many other weapons have seized solid.

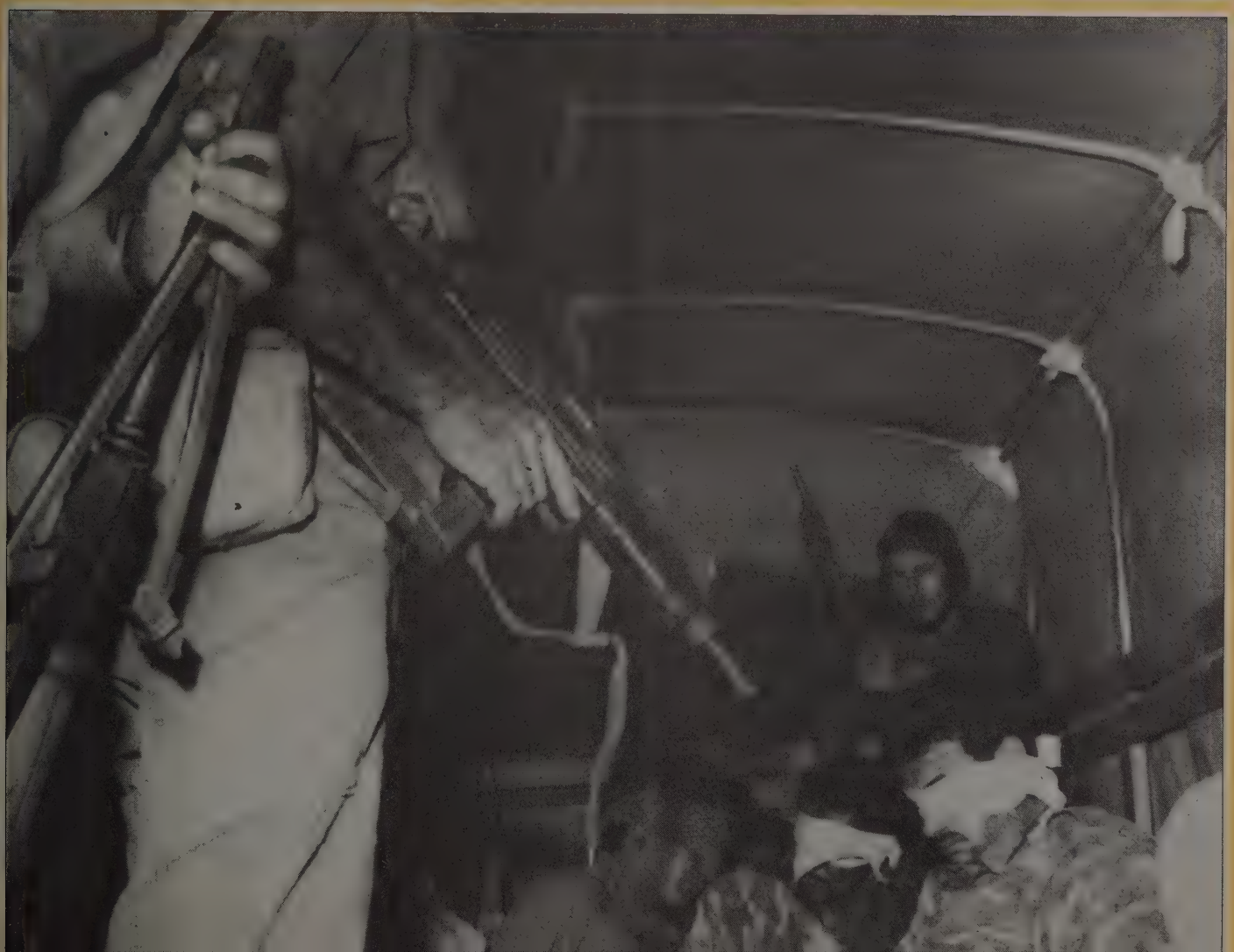
Gail's design was eagerly adopted and placed into production, initially in a series of small machine shops but eventually using the production facilities of the state-owned Israel Military Industries. By 1953 the weapon was in service, and in deference to its designer was named the UZI. Gail himself went on to a distinguished military career and retired as a lieutenant colonel but his name is still a virtual military fixture.

In its early years, the young Israeli nation was unable to rely on outside help and the need for an indigenous arms industry was paramount. Uziel Gail's UZI design was ideal: simple to manufacture, it entered service in 1953.

The UZI had its first major bout of conflict in Israeli hands during the Suez War of 1956. Before then it had been used more on the border patrols and clashes that marked the period, so that by the time it was used on a large scale most of the bugs inherent in any new weapon design had been eliminated. The troops liked the UZI: it was light, handy, and easy to aim and to operate. Versions with solid wooden butts were produced, but the type most favoured by the special forces such as the paratroops was the one with the folding metal butt. Only the special forces used the UZI as a standard weapon. The normal infantry and other units continued to use the standard service rifle of the day, but the UZI was and still is widely carried by second-line troops. It is small and light enough to be carried without any great inconvenience, and can be folded away into any small stowage space or even in a desk drawer.

Right: Two UZI-armed Israelis de-bus from an M3 half track covered by the .30 calibre Brownings of their comrades. The UZI first saw major action in the 1956 Arab-Israeli conflict in the hands of the Israeli airborne forces.

Below: The aftermath of another Arab incursion into Israel: the survivors of a PLO unit are driven away to captivity. Note the magazines clipped together on the UZI; the one out of the gun is empty. When the second magazine is full it projects under the barrel.



The UZI in Action

This latter point is important, for in Israel any member of the armed services is likely to be called into action at almost any time. Despite Israel's stringent and often irksome security precautions, terrorists are still able to strike at centres of population at any time. Consequently even off-duty personnel frequently carry their personal weapons with them at all times, and even desk-bound personnel keep their weapons close at hand. In many cases this means the UZI, and it is not an uncommon sight in any Israeli town or city to see groups of off-duty personnel enjoying themselves in a sidewalk cafe with UZIs nonchalantly slung from their chairs. Even the women personnel of the Israeli forces have to follow this course of action and the UZI is a common sight in shops and streets all over Israel.

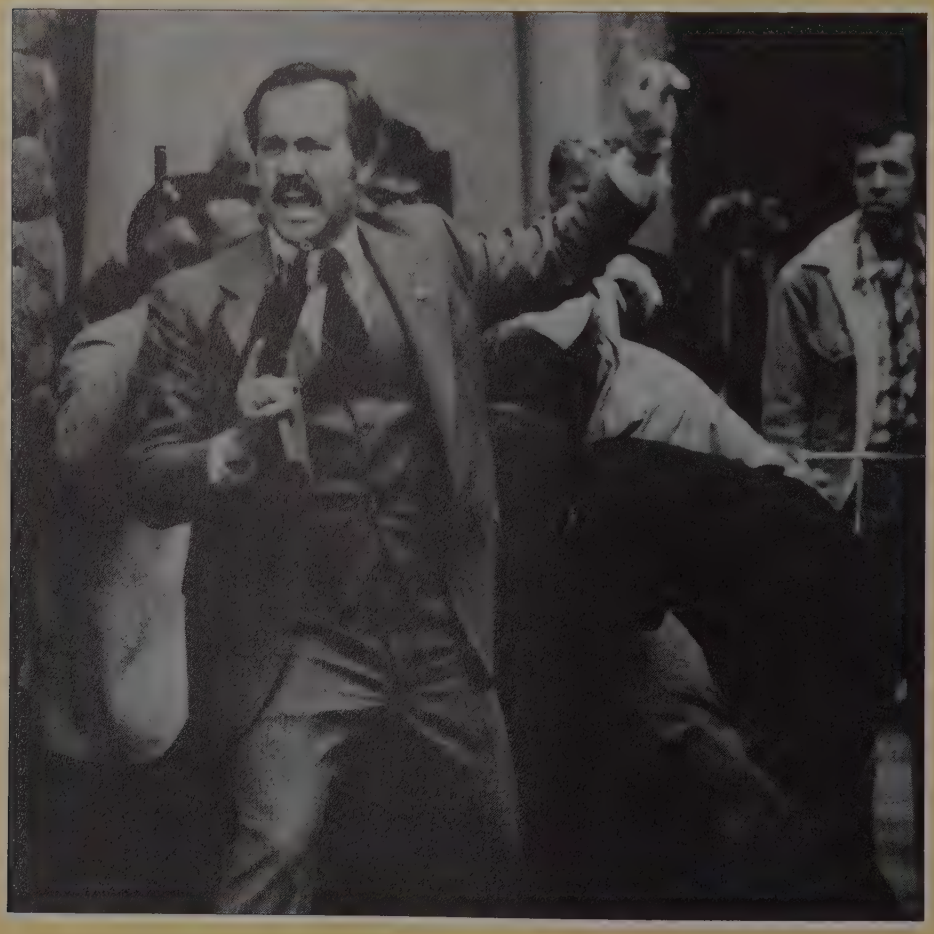
Thus the UZI is now a virtual military badge in Israel, and it may be seen emblazoned on belt buckles and even stamped on T-shirts. It would be safe to say that virtually every Israeli citizen is fully familiar with its workings and knows how to use it properly. Some of this knowledge has no doubt been learned the hard way in battle, for the UZI has been used in every Israeli-Arab conflict since 1956 and in many of the smaller campaigns that have marked the life of Israel. In nearly every newsreel or front-page photograph of Israeli soldiers in action an UZI may be discerned somewhere in the frame.

Typical of the use of the UZI in the hands of the Israeli special forces was the taking of Beaufort Castle on the night of 7 June 1982, during the opening stages of the Lebanese War. Beaufort Castle is situated just to the north of the Litani river inside Lebanese territory, but the Israelis had already advanced to the Litani in what at first appeared to be an anti-PLO campaign. To advance any farther north past the Litani Beaufort Castle had to be taken, for this old crusader fortress is located in a commanding position across any advance route to the north.

The UZI remains a favourite weapon of the Israeli special forces, who used it to great effect during the storming of Beaufort Castle on the night of 7 June 1982. Changing magazines in the dark is made easier by having the magazine housed in the pistol grip.

Needless to say the PLO was as aware of the importance of Beaufort Castle as the Israelis. Despite the age of the fortress the Palestinians had further improved the old fortifications and had manned not only the walls of the fort but the surrounding area. Inside the fortress walls the old underground areas had been further improved and were in use as stores and bomb-proof shelters. Not surprisingly the PLO considered the fortress to be virtually impregnable. It is set on a high and almost inaccessible promontory, and the PLO garrison was ready for an attack. It seemed as though the only way to take the position was by the time-honoured process of siege and a set-piece attack.

The Israelis thought otherwise. They had to take Beaufort Castle quickly in order to press on with advance to Beirut. They decided on a *coup de main* to be carried out by members of their special forces, who approached the castle from the area of the Aqiya Bridge over the deep gorge of the Litani river. The capture of this bridge was itself a major military achievement for it was wired for demolition and was captured before the charges could be fired. As the bulk of the Israeli central sector forces moved north one group moved in their half-tracks and Jeeps towards the castle as the evening of 6 June moved towards darkness. In the failing light they simply drove and fired their way through any PLO positions they encountered and rapidly came to under the walls of the fortress itself. Unfortunately it was not possible to rush the only track leading to the gates, so the steep walls of the point on which the castle stands had first to be scaled before even the walls could be reached. This had to be done by the old way with grappling irons, climbing skills and ropes. Under these combat conditions the UZI proved invaluable. It was easy to sling out of the way when climbing yet easy to get into action when required. In action its high fire rate was devastating at close ranges, and in the dark there was often no time to take deliberate aim. Thus the short UZI came into its own, for the Israelis could get their weapons on target much faster than their opponents armed with AK-47s.



Had he not been close enough to be tackled physically, there can be little doubt that Hinkley's attempt to kill President Reagan would have ended abruptly in a hail of 9-mm fire from the Presidential guards' UZIs.

Needless to say the PLO did not stand back and let the Israelis take the castle unopposed. They fought back with a ferocity that surprised the Israelis, and casualties were heavy on both sides. From time to time the Israelis used mortars to fire illumination flares, to allow them to see where they were and where they were going, but much of the fighting was at close quarters and at times (such as when they were still climbing their ropes) the Israeli troops' casualties were heavy. Some of the Israelis had to hang onto their ropes with one hand and fire their UZIs with the other. Some covering fire came from heavy machine-guns mounted on the halftracks far below, but the assault force had to supply most of its own covering fire.

Once the Israelis were over the walls the hand-to-hand fighting continued until just after midnight, when the Israelis took control of the fortress. Even then isolated bands of PLO fighters continued to fight, some to the last, though the castle was under Israeli control. As day broke the Israeli troops were able to appreciate fully the importance of the position they had taken. They were able to observe a wide stretch of terrain that stretched from the Mediterranean far to the west, over the coastal plain and up into the mountains of the interior. They could see the mechanized Israeli columns making their way north without risk of a powerful PLO stronghold in their rear.

Beaufort Castle was an action in which the UZI showed to its best advantage. In any close-quarter combat a short and handy weapon like the UZI provides any combatant with a tactical advantage, and when that advantage is allied to a determination to win such as that displayed by the Israeli soldiers who stormed the castle the result was inevitably a minor military classic.

Right: His UZI by his side, a gunner of No. 4 Battery, 305th Panzer Artillery, pauses by an M113 Armoured Personnel Carrier. The extensive use made of the UZI by West German forces is a great tribute to the design.

An important role fulfilled by the sub-machine gun is that of vehicle crew personal armament. In the confined space of a tank there is obviously no room for a full-size rifle. Here, the crew of a Bundeswehr Leopard pose with their folding-stock UZIs.

ITALY

9-mm Beretta Model 12s

During World War II the Beretta sub-machine guns were among the most highly-prized of all war trophies, and many remained for many years after the war in service with both military and paramilitary formations. The last of the 'war-time' Beretta variants was produced in 1949, and in 1958 an entirely new Beretta design was introduced. This owed nothing to previous designs and for the first time Beretta adopted the tubular receiver and stamped component construction that had for long been employed by many other manufacturers. The new design was the **Beretta Model 12**, but although it looked simple it was still a Beretta product, as was revealed by the overall high standard of finish and by its quality manufacture.

The Model 12 had an orthodox construction down to the 'wrap-around' bolt that was by then commonplace. This allowed it to be a short and handy weapon that as usual could be fitted with either a folding metal stock or a fixed wooden stock.

The Model 12 was sold extensively to such nations as Libya and Saudi Arabia, but only in small numbers to the Italian armed forces, who purchased the type for use only by special units. However, Beretta was able to negotiate licence production of the Model 12 in Indonesia and Brazil for local sales and export.

Beretta then decided to develop the basic design one stage further and produced the **Model 12S**. This is now the current Beretta sub-machine gun and production of the Model 12 has now ceased. Externally the Model 12S looks very like the Model 12 but there are some detail differences. One is the epoxy-resin finish, making the metal resistant to corrosion and wear. The fire selector mechanism on the Model 12 was of the 'push through' type, operated by pushing a button from either side of the receiver just over the pistol grip, but the Type 12S has a conventional single-lever mechanism with a safety that locks both the trigger and the grip safety. The folding butt, when fitted, now has a more positive lock for both the open and the closed positions, and some changes have been made to the sights. One laudable feature that has been carried over from the original Model 12 is the retention of the raised grooves that run along each side of the tubular receiver. These grooves act as catchers for any dirt or debris that find their way into the interior, and enable the Model 12S to operate under really muddy and arduous conditions.

To date the Model 12S has been purchased by the Italian armed forces in small numbers, and more were sold to Tunisia. Once again Beretta has been able to negotiate licence production and the Model 12S is now being offered by FN of Herstal, Belgium, as part of its small arms range. Incidentally, the Model 12 is one of the favoured weapons of 'Carlos', the international terrorist.

A dramatic break from pre-war Beretta designs, the Model 12 and 12S use heavy sheet metal stampings to form the magazine housing and receiver, but retain the elegant simplicity associated with Beretta.

The men of the Italian Parachute Brigade are mainly equipped with the BM59 rifle, but the Beretta 12S is better suited for close-range work. The 12S is designed to operate in harsh environments, having grooves along the sides of the receiver which catch any debris entering the weapon.

The 12S can be distinguished from the earlier Model 12 by the single lever fire selector and safety. The white 'S' is for safe, the red 'I' for semi automatic and the 'R' for full automatic.

Specification

Model 12S (metal stock version)
Calibre: 9 mm (0.354 in) Parabellum
Weight: loaded with 32-round magazine 3.81 kg (8.4 lb)
Length: with stock extended 660 mm (26 in) and with stock folded 418 mm (16.45 in)
Length of barrel: 200 mm (7.87 in)
Muzzle velocity: 381 m (1,250 ft) per second
Cyclic rate of fire: 500-550 rpm
Magazine: 20-, 32- or 40-round box

Right: Although widely exported, the Model 12 is only issued to Special Troops of the Italian army, the rest having to content themselves with the MAB 38/49. The Model 12 is a very steady weapon with remarkably low muzzle climb while firing in full automatic.

Royal Navy Part 3

Fleet Air Arm

Known as the Naval Air Command to the Admiralty, the Fleet Air Arm is primarily used as an extension of warships' weapon and sensor systems to engage and identify targets over the horizon. In 1984 the service had the following units in commission:

Squadron	*Aircraft*	*Primary role*
800	Sea Harrier FRS.Mk 1	combat air defence
801	Sea Harrier FRS.Mk 1	combat air defence
899	Sea Harrier FRS.Mk 1 and T.Mk 4N	operational training
810	Sea King HAS.Mk 5	ASW training
814	Sea King HAS.Mk 5	ASW
820	Sea King HAS.Mk 5	ASW
824	Sea King HAS.Mk 5	ASW
826	Sea King HAS.Mk 5	ASW
819	Sea King HAS.Mk 2A	ASW
849	Sea King AEW	airborne early warning
845	Wessex HU.Mk 5	air commando assault
846	Sea King HC.Mk 4	air commando assault
829	Wasp HAS.Mk 1	training/ASW/ hydrographic survey
815	Lynx HAS.Mk 2/3	anti-surface warfare/ASW
702	Lynx HAS.Mk 2/3	aircrew training
705	Gazelle HT.Mk 2	basic training
706	Sea King HAS.Mk 5	aircrew training
707	Wessex HU.Mk 5/ Sea King HC.Mk 4	aircrew training
750	Jetstream T.Mk 2	observer training
771	Wessex HU.Mk 5	SAR/training
772	Wessex HU.Mk 5	SAR/fleet requirements
FRADU	Hunter T.Mk 8C, Hunter GA.Mk 11, Canberra T.Mk 22, Canberra TT.Mk 18, Canberra T.Mk 4	fleet requirements

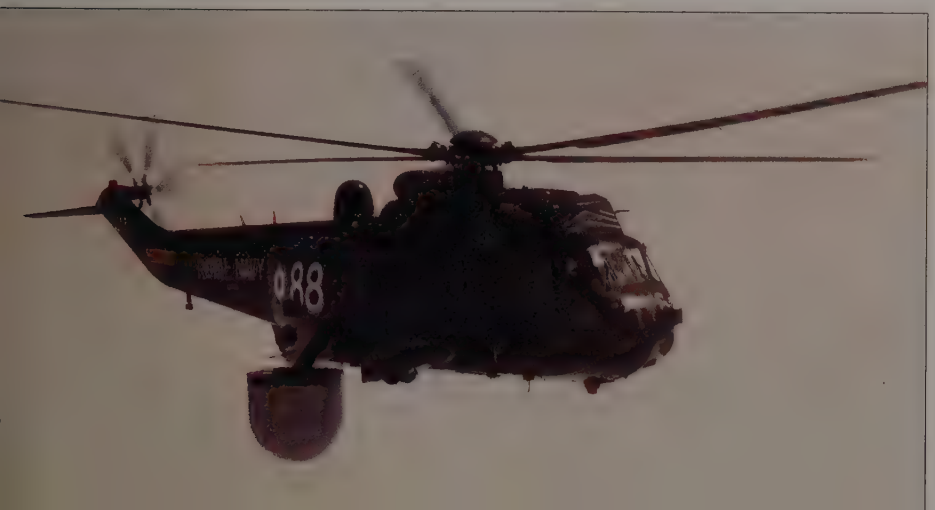
The Sea Harrier squadrons have secondary roles of photo and radar reconnaissance, ground attack and surface strike against enemy surface craft. For the air-to-surface role they can carry 454-kg (1000-lb) free-fall and retarded HE bombs, 272-kg (600-lb) BL755 cluster bombs, 51-mm (2-in) rocket pods and in the very near future the sea-skimming Sea Eagle anti-ship missile. They are credited with a tactical nuclear bomb delivery capability, for which they apparently carry a single 1/60-kiloton variable-yield 'Green Parrot' free-fall bomb. The Sea Harriers can also be used in a rapid response ASW role delivering a sonobuoy field to a predetermined datum point.

The primary ASW platform is now the Sea King HAS.Mk 5 with the Marconi LAPADS (lightweight acoustic processing and display system) sonobuoy processing equipment and mini-Jezebel sonobuoys. A magnetic anomaly detector is also being fitted together with the new Sea Searcher ASW/surface target radar. The active dunking sonar capability has been retained from the HAS.Mk 2 airframes which constitute the majority of the Sea King HAS.Mk 5 fleet. The armament can either be four Mk 46 or Stingray homing torpedoes, or four Mk 11 HE depth charges or, like its American counterpart, one B57 5-kiloton low-yield nuclear depth bomb. The elderly Mk 46 has a range of 10.9 km (6.8 miles) and a speed of 45 kts at 15.25 m (50 ft), but these figures are reduced to 5.45 km (3.4 miles) and 40 kts at 457 m (1,500 ft) depth because of the propellant used. The Mk 46 uses a spiral search pattern and can acquire targets at ranges up to 1.45 km (0.9 miles) on its active/passive homing system. Its replacement is the Stingray lightweight torpedo, which is a 'smart' weapon having a speed of 45 kts, a range of 7 km (4.35 miles) and a diving depth of 800 m (2,625 ft). Apparently the directed-charge warhead it carries is much more effective against the Soviet submarine hull than the blast type fitted to the Mk 46. The nuclear depth bomb, nicknamed 'Lulu', is a weapon that is used well away from friendly ships and submarines so that they are not damaged, and is the only nuclear ASW weapon the Royal Navy possesses. The other helicopter types which can carry the 'Lulu' are the Sea King HAS.Mk 2, the ship's flight Wasp HAS.Mk 1 and the ship's flight Lynx HAS.Mk 2/3. The Lynx can alternatively carry either two homing torpedoes or Mk 11 depth charges or (for its primary anti-surface role) two or four Sea Skua semi-active homing anti-ship missiles, whilst the Wasp can carry two Mk 44 or Mk 46 torpedoes or Mk 11 depth charges or two wire-guided AS.12 missiles.

Standard shipborne ASW and anti-shipping helicopter for smaller Royal Navy vessels, the Westland Lynx has recently been equipped with British Aerospace Sea Skua missiles, which were combat-tested under extremely difficult conditions during the South Atlantic campaign.

The Commando helicopters usually carry 7.62-mm (0.3-in) machine guns and 51-mm (2-in) rockets for ground suppression of assault zones. In this they will probably be backed by machine-gun, rocket and TOW fire from Royal Marine helicopters plus the weapons of any RAF aircraft available. The total lack of airborne early warning aircraft so keenly felt in the Falklands has now been resolved by the reactivation of No. 849 Squadron with Sea King AEW helicopters. However, the reasons why such a combination was rejected in the late 1960s to replace that squadron's Fairey Gannets still hold today and a new AEW platform must be found. The carriers will embark a flight of three Sea King AEWs as a normal part of their carrier air group.

For the future, the major re-equipment of the Sea King ASW squadrons will start in the late 1980s with the introduction of the EH101, whilst the Sea Harrier squadrons will receive both new-build and completely refurbished aircraft carrying a new airborne intercept radar suitable for use with the AIM-120 radar-guided missile that will supplement the infrared AIM-9L Sidewinder it uses at the moment as its primary air-to-air weapon.



The Westland Sea King in its HAS.Mk 5 form is the fleet's primary ASW platform, and since the harsh lessons of the Falklands it has also been equipped with a modified Searchwater radar to provide a limited degree of airborne early warning (AEW).

The Royal Navy returned to fixed-wing aircraft operations with the entry into service of the British Aerospace Sea Harrier. The three aircraft (from Nos 800, 899 and 801 Squadrons) are seen prior to their combat debut in the South Atlantic in 1982.

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WAR MACHINE

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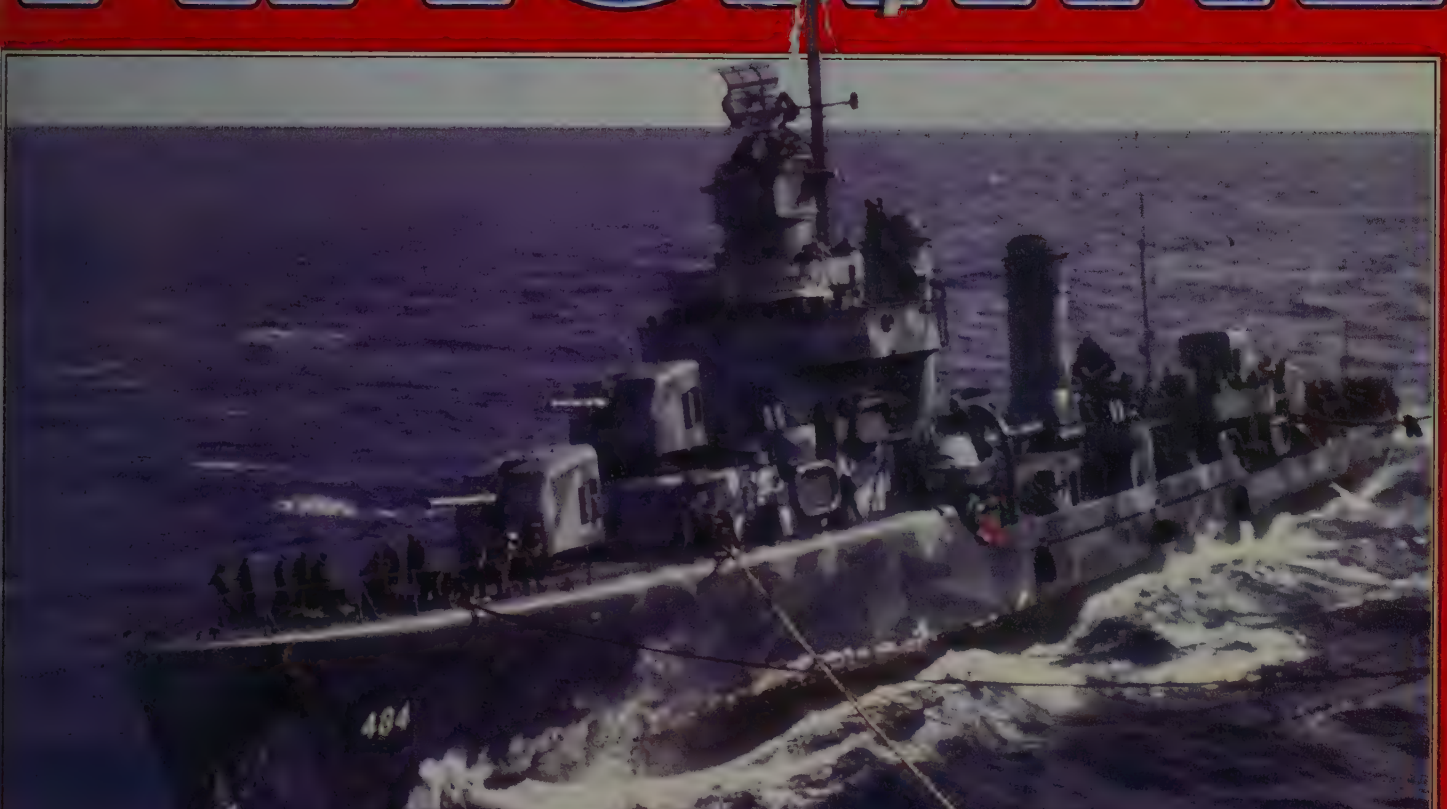

Destroyer Developments of World War II

Armed Forces of the World:
Royal Navy (Part 4)

The Battle of Vella Lavella

The *Kelly* in Action

Sink the *Haguro*!

A fully illustrated guide to Allied Destroyers of World War II

WAR MACHINE

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Allied Destroyers of World War II

Often described by over-colourful writers as 'the greyhounds of the ocean', the destroyer was an undeniably attractive picture at speed. Yet it could be argued that World War II saw the classic fleet destroyer without a function.

HMS Jersey *makes a turn at high speed in the wake of another member of her flotilla. In spite of an ability to take considerable punishment, 13 out of 24 'J', 'K' and 'N' class destroyers were lost.*

It was once common to see destroyers categorized as 'maids of all work', but a good case could be made for adding the rider '. . . and mistress of none'. Developed primarily to screen their own battlefleet and to mount torpedo attacks upon that of the enemy, fleet destroyers found themselves largely anachronistic in the very different Atlantic war of World War II. There were few opportunities to work in the 'traditional' manner, and the underestimated potency of air attack found destroyers unable even to defend themselves, let alone their charges. Lacking credible air defences, their only safety lay in their speed, for they were often not particularly manoeuvrable.

Atlantic convoys found destroyers with superfluous speed but insufficient range, together with inadequate capacity for anti-submarine warfare. In the Mediterranean the threat was more from the surface fleet than the submarine, and the destroyers' designed armament came into its own but, with the constrictions of geography, the losses caused by superior enemy air power were even more severe.

Events such as the torpedoing of the *Scharnhorst*, Narvik, 2nd Sirte and the *Haguro* sinking were exceptions rather than the rule and, even from the outset, the introduction of cheap, specialist AA and anti-submarine ships, geared to range and seakeeping rather than to speed, was inevitable.

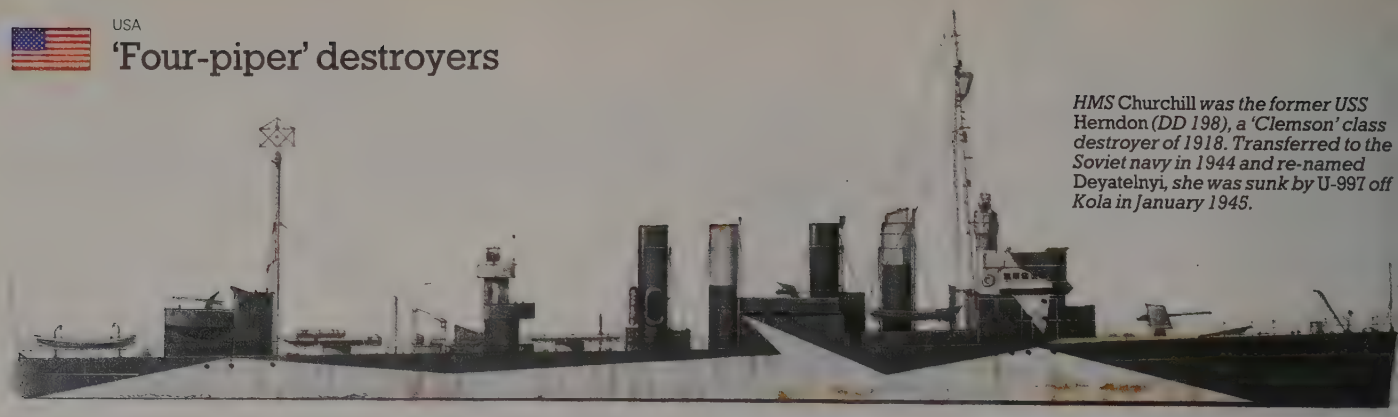
In the Pacific war things were very different, with two major fleets locked in close and bloody dispute. Though the carrier had emerged as the new capital ship, the remainder of the orthodox fleet still retained its role in supporting both the aircraft-carrier and the prolific but vulnerable breeds of amphibious warfare ship.

The Japanese proved adept and imaginative destroyer operators, expending torpedoes with a cheerful profligacy. Eventually the persistent Americans beat them at their own game, developing in the process something of an ideal destroyer, cheap yet durable, fast yet long-legged and capable of both offensive and defensive action. Though rather weak in anti-submarine potential, it had sufficient to cope with the curiously inept Japanese submarine arm.

The US Fleet anchorage at Kerema Retto is seen one day after US forces had finally secured Iwo Jima. A 'Fletcher' class destroyer, USS Bullard *(DD 660), passes in front of an 'Essex' class carrier of Task Force 58. One hundred and seventy-five Fletchers were built, the largest wartime class of destroyers.*

USA

'Four-piper' destroyers



HMS Churchill *was the former USS* Herndon *(DD 198), a 'Clemson' class destroyer of 1918. Transferred to the Soviet navy in 1944 and re-named* Deyatelnyi, *she was sunk by U-997 off Kola in January 1945.*

Known variously as **'four-pipers'**, or **'flush-deckers'**, the survivors of this very large group of American destroyers were, like the British 'V' and 'W' classes, in their second war. Resulting from the rapid expansion of the US Navy as it moved towards war in 1917, the design was derived directly from the 12-ship **'Tucker' class**. While having the same displacement and major dimensions, the latter differed in having a European-style raised forecastle. With two waist-mounted 102-mm (4-in) guns which needed forward arcs, this meant facetting the ships' sides. Six prototype **'Caldwell' class** ships changed the hull form to a long, easy sheerline that gave them a characteristic 'rimmed-by-the-stern' appearance and had the amidships guns resited on a house. Any improvement thereby must have been marginal as the forward arcs were still restricted, blast effects were significant, and weight was moved upwards on an already tender hull. No less than 12 torpedo tubes were fitted, mainly because the sheer quantity of tophamper precluded centreline mounting; only two triples could thus bear on each beam. The main production series, the 111 **'Wickes' class** (DD 75) and the 156 **'Clemson' class** (DD 186), retained these features but were given higher installed power for 35 kts when launched between 1918 and 1921.

No less than 93 were scrapped in the early 1930s under the terms of the London Naval Treaty. During July 1940, immediately after Dunkirk, the Royal Navy was desperately short of escorts and took over 50 in the famous exchange for a 99-year US lease on colonial base rights. Many were in dubious condition and though scarcely the '50 Ships that Saved the World' beloved by journalists, they did their turn, though usually in a cut-down form.

The USS ***Reuben James*** (DD 245) was one of two US destroyers torpedoed in October 1941 while covering convoys before the USA's official entry into the war. In December 1941, a dozen four-pipers were the only US destroyers in the Far Eastern theatre, five being lost during the unequal struggle of the ABDA naval force. Many worked throughout the war, funnels removed or trunked, converted to escorts, minelayers, minesweepers or small auxiliaries.

Specification

'Clemson' class (as built)
Displacement: 1,190 tons standard
Dimensions: length 95.78 m (314.25 ft); beam 9.37 m (30.75 ft); draught 2.82 m (9.25 in)
Propulsion: two sets of geared steam turbines delivering 20507 kW (27,500 shp) to two shafts
Performance: maximum speed 35 kts
Armament: four single 102-mm (4-in) and one 76.2-mm (3-in) AA gun, and four triple 533-mm (21-in) torpedo tube mountings
Complement: 135

Above: HMS Wells, *a 'Wickes' class destroyer, is seen making smoke in 1942. These old ships gave valuable service.*

Below: USS Greer *is notable for the fact that she was attacked by the German U-652 and replied with depth charges. This would not normally be considered unusual except for the fact that it occurred on 4 September 1941, more than three months before Pearl Harbor.*

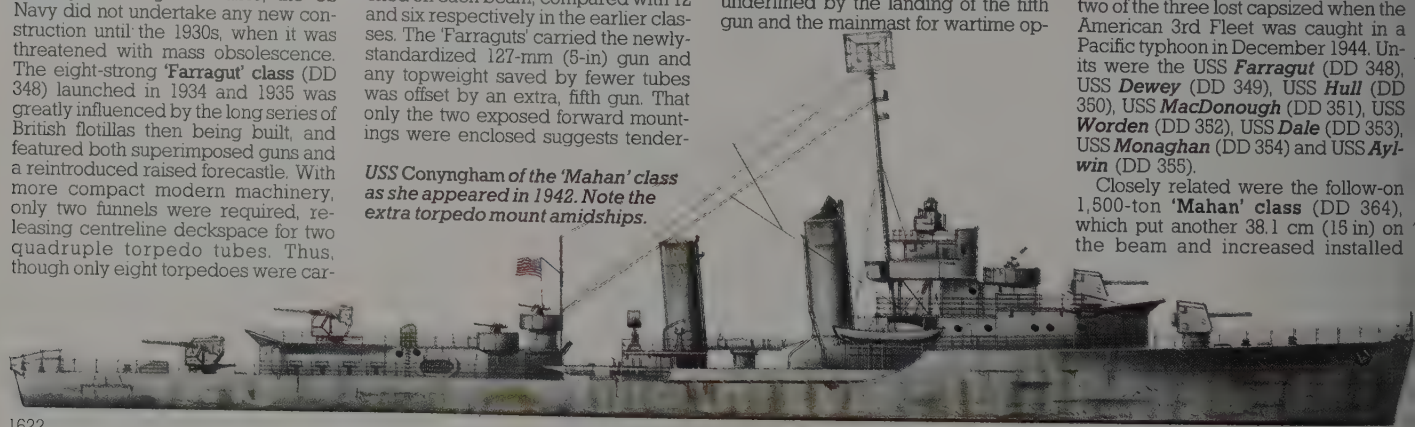
USA

'Farragut' class, 'Mahan' class and 'Porter' class destroyers

With more than adequate warbuilt destroyer tonnage available, the US Navy did not undertake any new construction until the 1930s, when it was threatened with mass obsolescence. The eight-strong **'Farragut' class** (DD 348) launched in 1934 and 1935 was greatly influenced by the long series of British flotillas then being built, and featured both superimposed guns and a reintroduced raised forecastle. With more compact modern machinery, only two funnels were required, releasing centreline deckspace for two quadruple torpedo tubes. Thus, though only eight torpedoes were carried, the full number could be launched on each beam, compared with 12 and six respectively in the earlier classes. The 'Farraguts' carried the newly-standardized 127-mm (5-in) gun and any topweight saved by fewer tubes was offset by an extra, fifth gun. That only the two exposed forward mountings were enclosed suggests tenderness from the outset, a suspicion underlined by the landing of the fifth gun and the mainmast for wartime operations. Despite these modifications, two of the three lost capsized when the American 3rd Fleet was caught in a Pacific typhoon in December 1944. Units were the USS ***Farragut*** (DD 348), USS ***Dewey*** (DD 349), USS ***Hull*** (DD 350), USS ***MacDonough*** (DD 351), USS ***Worden*** (DD 352), USS ***Dale*** (DD 353), USS ***Monaghan*** (DD 354) and USS ***Aylwin*** (DD 355).

Closely related were the follow-on 1,500-ton **'Mahan' class** (DD 364), which put another 38.1 cm (15 in) on the beam and increased installed

USS Conyngham *of the 'Mahan' class as she appeared in 1942. Note the extra torpedo mount amidships.*



power. The five-gun main battery was retained and a third quadruple torpedo tube mount was added, the forward one now being on the centreline and the others sided. The 'Mahans' left enduring images by way of the presence of some of the 18 ships at Pearl Harbor. Both the fireball of the exploding USS ***Shaw*** (DD 373) and the drunken, debris-strewn ruins of the USS ***Cassin*** (DD 372) and USS ***Downes*** (DD 375) give vivid witness to the efficiency of that Sunday-morning onslaught.

Built at the same time in 1934 and 1935 were the eight enlarged 1,800-ton **'Porter' class** (DD 356) destroyers. Though these British-style leaders were some 12.2 m (40 ft) longer, their beam was scarcely increased and they were unable to accommodate the burden of four of the new twinned gunhouses, two of which were usually landed. Not to be beaten, the designers followed on with the five 1,850-ton **'Somers' class** (DD 381) destroyers of 1937 and 1938, which not only had eight guns but also a third quadruple torpedo tube mounting. These too suffered severe trimming of armament and this unhealthy trend toward overarming was reversed somewhat by a reversion to single 127-mm (5-in) guns. Even so, with an eye to Pacific operations, US destroyers were larger than British equivalents, faster and with greater endurance.

Specification

'Farragut' class (as built)
Displacement: 1,395 tons standard
Dimensions: length 104.01 m (341.25 ft); beam 10.41 m (34.16 ft); draught 2.69 m (8.83 ft)
Propulsion: two sets of geared steam turbines delivering 31916 kW (42,800 shp) to two shafts
Performance: maximum speed 36.5 kts
Armament: five single 127-mm (5-in) DP and four machine-guns, and two quadruple 533-mm (21-in) torpedo tube mountings
Complement: 250

The massive bulk of USS South Dakota *dwarfs the 'Mahan' class destroyers USS* Dunlap *and* Fanning, *recognizable by their shielded gun mounts forward and unshielded guns aft. Note that the inner of the two appears to have lost her bow in an accident.*

USA

'Gridley' class and 'Sims' class destroyers

USS Trippe, *a 'Benham' class destroyer, leaves Pearl Harbor in 1940. The 'Benhams' were derivatives of the 'Bagley' class, which were 'Gridleys' built by the Navy Yards. USS* Trippe *ended her days at Bikini in 1948, as an atom bomb target.*

Concurrent with the overarmed 'Somers', the US Navy built 22 **'Gridley' class** (DD 380) destroyers, smaller ships but much better balanced. The main battery was halved, four single 127-mm (5-in) L/38 guns saving considerable topweight for investment in an unprecedented 16-tube torpedo armament. The four quadruple mountings were placed sensibly low, at upper deck level, two per side. Later, some took triples and those on Atlantic duty usually landed two. A prominent feature of both the 'Gridleys' and their first derivatives, the 12 1,570-ton **'Sims' class** (DD 409) destroyers, was the single enormous funnel casing, trunked to serve two adjacent boiler spaces.

In the variant, one set of tubes was initially traded for an extra 127-mm (5-in) gun. Length was also increased by 1.98 m (6.5 ft) to allow for increased bunkerage but, even with the extra size and displacement, the wartime 'Sims' usually ended one gun and a set of tubes lighter. Both classes were high-powered by British standards, the extra length of the 'Sims' allowing for better lines and an extra knot of speed over the similarly-powered 'Gridleys'. Wartime losses were five 'Gridleys' and five 'Sims'.

Six 'Gridleys' were present at the debacle of Savo Island, their potential being wasted largely through faulty tactical doctrine. With 96 nominal torpedoes between them, for instance, only eight were recorded as launched, none hitting. This was in total contrast with the Japanese. USS ***Blue*** (DD 387) and USS ***Ralph Talbot*** (DD 390) were the two radar pickets whose unaccountable lack of attention, even after a warning, allowed Mikawa's cruiser force to penetrate the strait.

Of the follow-ons, the USS ***Sims*** (DD 409) herself was sunk before the crucial main action of the Coral Sea was actually joined. She and a fleet oiler were caught alone by Japanese dive-bombers which, inflicting fatal damage, also reported them incorrectly, allowing the American main force to approach unobserved.

All pre-war-built destroyers were written off after August 1945 and no less than 11 from these two groups were expended at the Bikini nuclear site.

Specification

'Gridley' class (as built)
Displacement: 1,500 tons standard
Dimensions: length 104.11 m (341.58 ft); beam 10.97 m (36 ft); draught 2.97 m (9.75 ft)
Propulsion: two sets of geared steam turbines delivering 36539 kW (49,000 shp) to two shafts
Performance: maximum speed 36.5 kts
Armament: four single 127-mm (5-in) DP and five machine-guns, and four quadruple 533-mm (21-in) torpedo tube mountings
Complement: 250

USA

'Benson' class and 'Livermore' class destroyers

On the same day in October 1939, the Boston Navy Yard launched four destroyers, the last pair of the 'Sims' series and the first two **'Benson' class** (DD 421) destroyers. Though the same hull and machinery was used, the later ships had the boiler spaces divided for improved damage control, necessitating a return to two funnels. A realistic armament was fitted in five 127-mm (5-in) guns and two quintuple sets of torpedo tubes, but even this was too much for wartime conditions, one gun and a set of tubes being landed. Only the first 24 hulls were completed with the full designed armament. The reduced fit was the most modest since the American destroyer adopted the 127-mm (5-in) gun.

This sound design was used for the first major series in the rapid expansion of the US Navy as it headed toward another war: 96 'Bensons' were built between 1939 and 1943, and though the last 64 were officially the separate **'Livermore' class**, there were only marginal differences, leading to the latter type having a slightly greater displacement.

They were the last American destroyers to have the European type of raised forecastle, with its characteristic rounded sheerstrake. Though this feature took a high freeboard farther aft and increased enclosed volume, it introduced a high stress concentration at the hance. Amidships, where British destroyers tended to be very wet, the Americans had bulwarks with continuous freeing ports running to a point abaft the after funnel. This was possible because the continuous topside casing required that torpedo tubes were set on one level higher than the upper deck. This arrangement alone accounted for many American destroyers not being able to carry their full designed armament.

On 10 April 1941, near Iceland, the USS ***Niblack*** (DD 424) became the first US destroyer during World War II to prosecute a suspected submarine contact by depth charging and in the following October, while covering convoy SC 48, the USS ***Kearny*** (DD 432) became the first US warship to be torpedoed.

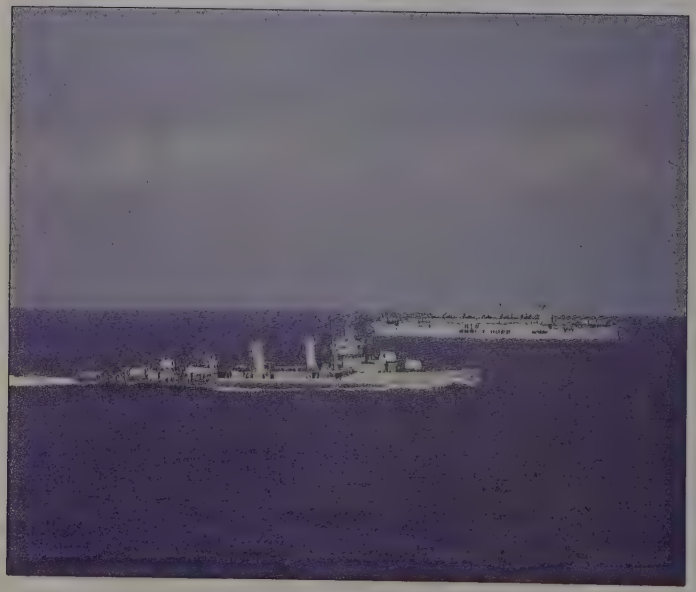
Many of the later 'Bensons' were converted to high-speed destroyer/minesweeper (DMS) at the expense of a further gun and the remaining tubes.

Specification

'Benson' and 'Livermore' classes (as built)
Displacement: 1,620 tons standard
Dimensions: length 105.99 m (347.75 ft); beam 11.05 m (36.25 ft); draught 3.12 m (10.25 ft)
Propulsion: two sets of geared steam turbines delivering 37285 kW (50,000 shp) to two shafts
Performance: maximum speed 37 kts
Armament: five single 127-mm (5-in) DP and four machine-guns, and two quintuple 533-mm (21-in) torpedo tube mountings
Complement: 250

USS Benson *as she appeared prior to Pearl Harbor. Officially 1,600-ton destroyers, by the end of the war the class were usually displacing nearly 2,400 tons at full load.* Benson *was transferred to Taiwan in 1954, serving until 1975.*

USS Farenholt *(DD 491) is seen from the carrier USS* Wasp *(CV-8) as she comes alongside to re-supply.* Farenholt *was to survive the fierce fighting in the Solomons, but the carrier was not so lucky. Within three weeks of the photo being taken, she was torpedoed to the south of Guadalcanal.*



Left: A 'Benson' class destroyer cleaves the water as she forms part of the protection for an escort carrier. The 'Bensons', together with the almost identical 'Gleave' and 'Livermore' classes, were the first large-scale wartime US destroyer programme, 96 being built between 1939 and early 1943.

Above: USS Buchanan *(DD 484) replenishes from USS* Wasp *(CV-7) in June 1942.* Buchanan *survived the war to be sold to Turkey, where she served under the name* Gelibolu. *One of her main guns was removed, and her light AA replaced by four 76-mm (3-in) guns.*

USA

'Fletcher' class destroyers

Backbone of the US destroyer force in the Pacific, the 'Fletchers' displayed strong surface warfare armament typical of that theatre, where clashes with Japanese destroyers could often be expected.

Though the extensive 'Benson' class achieved its aim of putting the US destroyer-building industry onto a war footing, the design had limitations for a Pacific war, both in terms of endurance and its curtailed weapons fit. Even before the end of the programme, therefore, the first of an improved class were going into the water. The first two of this **'Fletcher' class** (DD 445) went down the ways in February 1942 and the last four of 175 ships on the same day in September 1944 at Puget Sound Navy Yard.

The designed armament of the 'Bensons' was carried by the new ships on a hull some 8.53 m (28 ft) longer and 0.91 m (3 ft) beamier. A great improvement was the substitution of licence-built 20-mm and 40-mm AA guns in place of the earlier 12.7-mm (0.5-in) machine-guns. No mainmast was fitted, and a further lowering of the centre of gravity was achieved through reversion to the flush-decked hull, also considered stronger. Funnels were shorter and, as a result, fitted with pronounced caps. Four units, in an unsuccessful experiment, had their no. 3 gunhouse and after tubes replaced by a catapult and scout aircraft.

Though the 'Fletchers' were generally sent quickly to the Pacific on completion, those built on the Atlantic seaboard saw some service there. Two of the earliest, for instance, the USS ***Fletcher*** (DD 445) and USS ***O'Bannon*** (DD 450), found themselves hurriedly diverted to the Windward Passage where two crossing convoys were being simultaneously assailed by U-boats. The existing scratch escort was led by an ex-US flush-decker, HMS *Churchill* but, even reinforced, they were unable to prevent the loss of five merchantmen. The *O'Bannon* fought also in the confused night action off Vella Lavella where three of six US destroyers, including four early 'Fletchers', tangled impetuously and unwisely with six Japanese destroyers involved in a garrison withdrawal. In a hail of torpedoes and gunfire the USS ***Chevalier*** (DD 451) was torn in two, the *O'Bannon* ploughing into her. The enemy *Yagumo* was immediately torpedoed herself but the sole American still under way, seeking still to close the enemy transports, was also hit by one of 16 torpedoes launched at her. Though only the *Chevalier* was actually lost, the Japanese had succeeded in their aim.

Specification

'Fletcher' class (as built)
Displacement: 2,050 tons standard
Dimensions: length 114.76 m (376.5 ft); beam 12.04 m (39.5 ft); draught 5.41 m (17.75 ft)
Propulsion: two sets of geared steam turbines delivering 44742 kW (60,000 shp) to two shafts
Performance: maximum speed 37 kts
Armament: five single 127-mm (5-in) DP, three twin 40-mm AA and four single 20-mm AA guns, and two quintuple 533-mm (21-in) torpedo tube mountings
Complement: 295

USS* Stevens *(DD 479) leaves Charleston in December 1942 after completing her trials. By this time, a year after Pearl Harbor, American industry was becoming fully geared up for war, and 'Fletcher' class vessels were coming off the slips at a rate of four per month.

Right: Many wartime American destroyers had long post-war careers, USS Cowell *seen here off Hawaii in 1963 serving until 1971. Acquired by Argentina in that year, she served as the* Almirante Storni *until 1982, when she was decommissioned.*

USA

'Allen M. Sumner' class and 'Gearing' class destroyers

To squeeze in more AA armament, the later 'Fletchers' needed to have their director tower lowered by way of compensation. The next design step was to give the hull an extra 45.7 cm (18 in) of beam and to adopt the new twinned 127-mm (5-in) L/38 gunhouse. Three of these occupied less axial length than the five singles of the 'Fletcher' class and enabled a six-gun main battery to be shipped with very little weight penalty. Less demand on space at the after end enabled the rearmost tubes to be brought well aft, improving weight distribution and freeing the area abaft the stacks for three quadruple 40-mm AA mountings. These effective weapons, used here for the first time in destroyers, thus enjoyed wide arcs and, being closer to amidships, reduced the ship motion that degraded accuracies. The result was the **'Allen M. Sumner' class** (DD 692).

Twelve of this 58-strong class were converted to destroyer-minelayers during construction, sacrificing both sets of tubes for a 100-mine capacity Some were further modified for radar-picket duty but, in warning the main body of the fleet against the approach of the *kamikaze*, they often became

USS* Perkins, *in common with many of the 'Gearing' class, received extensive modification post-war, serving as a high-speed ASW carrier escort. Seen off Oahu in 1966,* Perkins *was transferred to the Argentine navy as the* Commodoro Py *in 1973. She served during the Falklands war.

victims themselves. The USS ***Aaron Ward*** (DM 34) became a constructive total loss off Okinawa after having been struck by five, while the USS ***Laffey*** (DD 724) actually survived six such hits.

Yet more space and endurance requirements stretched the basic 'Sumner' hull by a further 4.27 m (14 ft) to produce the ***'Gearing' class*** (DD 710), which was to prove the ultimate stage in this long series of closely-related classes. Externally these larger ships were distinguishable primarily through their more widely-spaced funnels. With the threat from the rump of the Japanese surface fleet by 1945 significantly less than that posed by aircraft, it was also common to sacrifice a set of tubes for either a braced tripod bearing a surveillance radar antenna, or an extra quadruple 40-mm mounting. Only with peacetime did the new 76.2-mm (3-in) automatic guns, which could disintegrate a suicide aircraft, become generally available, being fitted usually during the extensive FRAM modernizations that converted destroyers to fast anti-submarine escorts, a primary function for which they were not intended.

Specification
'Allen M. Sumner' class (as built)
Displacement: 2,200 tons standard
Dimensions: length 114.8 m (376.5 ft); beam 12.5 m (41 ft); draught 5.79 m (19 ft)
Propulsion: two sets of geared steam turbines delivering 44742 kW (60,000 shp) to two shafts
Performance: maximum speed 36.5 kts
Armament: three twin 127-mm (5-in) DP and three quadruple 40-mm AA guns, and two quintuple 533-mm (21-in) torpedo tube mountings
Complement: 350

USS Gearing *as she appeared on completion in May 1945. Lengthened versions of the 'Allen M. Sumner' class, the large 'Gearings' were the ultimate US wartime destroyer class. Some remain in service today with the US Reserve Fleet.*

UK

'V' and 'W' class destroyers

Instantly recognizable through their two thick and thin funnels of unequal height, the **'V' class** and **'W' class** destroyers served the Royal Navy well for over a quarter of a century. Stemming from five new half-leaders ordered in 1916 to counter rumoured German construction, the class introduced superimposed guns both forward and aft, and featured both extra length and freeboard for improved seaworthiness. Their limitations were in shipping only four torpedo tubes and in needing to take the machinery of the smaller Admiralty 'R' class but, though a little underpowered, the first of the class, HMS ***Valkyrie***, still made nearly 35 kts on trials in June 1917.

Once proved, the design was extended by 25 'V' class and then 25 'W' class destroyers, the latter differing mainly in adopting two triple torpedo tube mountings. Stability proving no problem, the ***'Modified V & W' class*** then followed (an order for 54 ships being placed in early 1918) to mount 119.4-mm (4.7-in) guns in place of the earlier classes' 102-mm (4-in) weapons, their projectiles weighing 22.7 kg (50 lb) instead of 15.9 kg (35 lb). With the Armistice, most were cancelled, only HMS ***Vansittart***, HMS ***Venomous***, HMS ***Verity***, HMS ***Veteran***, HMS ***Volunteer***, HMS ***Wanderer***, HMS ***Whitehall***, HMS ***Whitshed***, HMS ***Wild Swan***, HMS ***Wishart***, HMS ***Witch***, HMS ***Witherington***, HMS ***Wivern***, HMS ***Wolverine***, HMS ***Worcester*** and HMS ***Wren*** being built. One was lost during World War I and two more in the Baltic in 1919. The survivors formed the backbone of the fleet destroyer strength for most of the 1920s and, all but for a further five, went on to their second war in 1939.

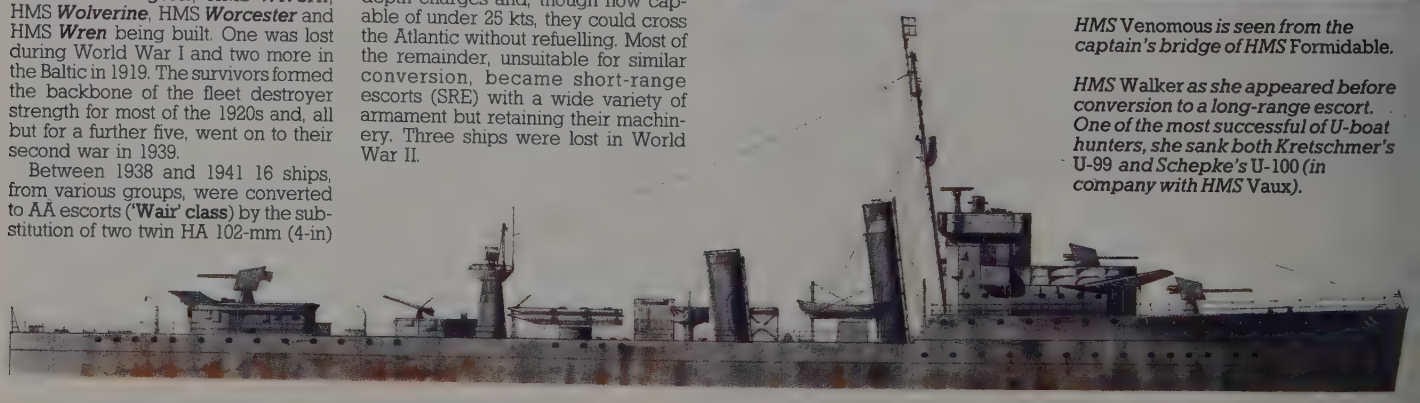
Between 1938 and 1941 16 ships, from various groups, were converted to AA escorts (**'Wair' class**) by the substitution of two twin HA 102-mm (4-in) guns and a quadruple 2-pdr in place of the original armament. Another 20 were suitable for conversion to long-range escorts (LRE) by removal of the forward boiler and funnel to give enhanced bunker capacity. The original armament was cut back in favour of an ahead-firing Hedgehog and extra depth charges and, though now capable of under 25 kts, they could cross the Atlantic without refuelling. Most of the remainder, unsuitable for similar conversion, became short-range escorts (SRE) with a wide variety of armament but retaining their machinery. Three ships were lost in World War II.

Above: In 1945, HMS Watchman *was serving as a long-range escort, with her forward boiler and funnel removed to allow for extra fuel and 'A' gun replaced by an ahead-firing Hedgehog anti-submarine mortar unit. With the extra fuel she had transatlantic range.*

Specification
'Modified V & W' class (as built)
Displacement: 1,120 tons standard and 1,505 tons full load
Dimensions: length 95.1 m (312 ft); beam 8.99 m (29.5 ft); draught 3.28 m (10.75 ft)
Propulsion: two sets of geared steam turbines delivering 20134 kW (27,000 shp) to two shafts
Performance: maximum speed 34 kts; endurance 6437 km (4,000 miles) at 15 kts
Armament: four single 119.4-mm (4.7-in) and one 76.2-mm (3-in) guns, and two triple 533-mm (21-in) torpedo tube mountings
Complement: 134

HMS Venomous *is seen from the captain's bridge of HMS* Formidable.

HMS Walker *as she appeared before conversion to a long-range escort. One of the most successful of U-boat hunters, she sank both Kretschmer's* U-99 *and Schepke's* U-100 *(in company with HMS* Vaux*).*



The Battle of Vella Lavella

Unlike the British experience of war in the West, the Pacific war saw a significant use of destroyers in their original attack role, especially in the bitter campaign for the Solomons.

Though not one of World War II's larger actions, Vella Lavella typifies the vicious night encounters of the Solomons campaign and illustrates why both American and Japanese destroyers remained 'traditionally' armed. Some 320 km (200 miles) from Guadalcanal, the island of Vella Lavella was invaded by the Americans in August 1943 and, by the following month, the comparatively quiescent Japanese garrison was penned into the north western corner. The Japanese planned to evacuate them on the night of 6-7 October in three destroyers and some auxiliaries covered by six seasoned destroyers of the 'Tokyo Express' under Rear Admiral Matsuji Ijuin in the destroyer *Akigumo*.

The force was sighted by air reconnaissance and its position and likely destination signalled to Captain Frank R. Walker, commanding the destroyers USS *Selfridge*, *USS Chevalier* and USS *O'Bannon*, who was directed to rendezvous with three more destroyers off the likely Japanese evacuation point. Walker knew that he, in turn, had been sighted by an enemy aircraft but when, at 22.30, radar contacts were reported to the west he immediately advanced toward what he knew to be a greatly superior force even though his reinforcement had not yet arrived.

With the evacuation force keeping clear, Ijuin's destroyers split four and two and moved into two roughly parallel columns. They almost crossed Walker's 'T' at 22.45 but, still sizing up the strength of the Americans, took no action. His mind apparently made up, the Japanese commander made two abrupt changes of course but put his force into some confusion. At the second change of course, the range had dropped to about 6400 m (7,000 yards) and Walker opened the bowling with the Japanese tactic of a torpedo salvo: 14 torpedoes were fired, the Japanese at the time largely masking each other's fire. It was a dark night, lit by a quarter moon but punctuated by rain squalls and both sides were moving at high speed. With the American torpedoes running the nearest Japanese destroyer, the *Yagumo*, broke formation and now at only 2745 m (3,000 yards) range, turned three parts of a circle, launching eight torpedoes as she turned. Walker's ships smothered her with gunfire while Ijuin, his manoeuvre frustrated, pulled his remaining three ships into line ahead and turned 16 points under cover of smoke.

At 23.05 the impetuous *Yagumo* was hit by an American torpedo but, almost simultaneously, the *Chevalier*, second in the US line, was struck by one from the *Yagumo*. Her bows gone, she slewed around at almost full power and was promptly rammed by the tail-ender, *O'Bannon*, who was thus also immobilized.

Walker, now alone in the *Selfridge*, bore on after the pair of Japanese yet unengaged. About six minutes before, however, these had launched their full complement of 16 torpedoes and the *Selfridge* ran into them. One exploded beneath 'B' gun, removing the complete bow section and leaving the heavy twin mounting hanging by a hair over the mangled forward plating.

Warned of the approach of American reinforcements, Ijuin chose to quit while he was winning and, having launched his remaining torpedoes at 13-km (8-mile) range toward his now-stationary adversaries, he withdrew at high speed. It was 23.17 and the whole affair had taken only 22 minutes.

Only 15 minutes later Walker's reinforcements arrived, finished off the stricken *Chevalier* and covered the withdrawal of the other two. Materially honours were even, with one ship lost to each side, but the Japanese gained the victory in that, keeping the Americans occupied, they permitted their evacuation force to perform its mission without disturbance.

O'Bannon, Chevalier and another destroyer of Desron (Destroyer Squadron) 21 head for the Solomons, where within months they were to see violent action.

The naval fighting around the Solomons was notable for the high proportion of actions which took place at night. Vella Lavella was no exception, with the Japanese gaining a tactical victory.

UK

'A' class destroyer

Not until the mid-1920s did the Admiralty deem it necessary to order a pair of prototype destroyers with a view to replacing war-built tonnage. These, HMS ***Amazon*** and HMS ***Ambuscade***, were heavily based on the 'Modified V & W' class but with a contract speed of 37 kts. This was possible only by the extra power developed by the new Admiralty three-drum boiler and steam superheat. With small modifications, the design of this pair formed the basis of a full **'A' class** of eight and a leader (HMS ***Codrington***, lost in 1940) ordered in the 1927 programme for completion in 1929 and 1930. These were followed, alphabetically, by a flotilla per year, with surprisingly few 'improvements' up to the **'I' class** boats of 1935. It was an excellent design: simple yet robust, with an austere elegance that influenced foreign construction.

Destroyers, now larger and more capable, worked in smaller groups than before, each flotilla having a leader, enlarged for Captain (D)'s staff and carrying an extra gun, largely of prestige value, between the funnels. The armament of the 'A' class destroyers was improved over that of their prototypes by the provision of extra elevation to the guns and quadruple in place of triple torpedo tube banks. To improve wartime topweight margins, 'Y' gun was generally landed, over 2 m (6.6 ft) were lopped from the after funnel, and the tall mainmast was replaced by a short jigger.

In June 1940, HMS ***Ardent*** and HMS ***Acasta*** perished gallantly off the Norwegian coast in a vain attempt to defend the carrier HMS *Glorious* from the *Scharnhorst* and *Gneisenau*, of which the former was torpedoed. HMS ***Achates*** was also mined off Norway, her whole forward section needing to be rebuilt. She, too, was lost in valiant circumstances during the desperate action off North Cape on the last day of 1942: while Sherbrooke and four 'A' class destroyers kept at bay a German 'pocket battleship', a heavy cruiser and six large destroyers, the *Achates* shielded their convoy with smoke, virtually until going under from the effects of 203-mm (8-in) shell damage. The convoy was saved by the timely arrival of two British 152-mm (6-in) cruisers. The other 'A' class destroyers were HMS ***Acheron*** (lost in 1940), HMS ***Active***, HMS ***Antelope***, HMS ***Anthony*** and HMS ***Arrow***.

***HMS* Achates *was seriously damaged by mining during the retreat from Norway, but after extensive rebuilding went on to glory in defending a Soviet-bound convoy from the* Lützow *and the* Admiral Hipper.**

Specification

'A' class (as built)
Displacement: 1,330 (leader 1,520) tons standard and 1,770 tons full load
Dimensions: length 98.5 m (323 ft); beam 9.83 m (32.25 ft); draught 2.16 m (7.08 ft)
Propulsion: two sets of geared steam turbines delivering 25354 kW (34,000 shp) to two shafts
Performance: maximum speed 35 kts; endurance 8851 km (5,500 miles) at 15 kts
Armament: four (leader five) single 119.4-mm (4.7-in) and two single 2-pdr 'pompom' AA guns, and two quadruple 533-mm (21-in) torpedo tube mountings
Complement: 138

UK

'J' class, 'K' class and 'N' class destroyers

The 16 'Tribals' were a class apart but, in answering directly the increasing size and power of foreign destroyers, they were also a tacit acknowledgement of the need for a larger general-purpose fleet destroyer for the Royal Navy. Following the extended 'A' to 'I' classes of flotillas, a new design was agreed only after considerable debate. Visually, it departed considerably from earlier practice. Two boilers replaced the earlier three, allowing for a single funnel, generously proportioned to balance the profile. Three of the twin 119.4-mm (4.7-in) gunhouses used in the 'Tribals' were shipped, allowing space for a second bank of torpedo tubes of the quintuple pattern introduced with the 'I' class. This heavy torpedo armament showed a continuing commitment to a form of attack that, in the event, was used only seldom by the British. To improve the firing arc of the after gun mounting a mainmast was not stepped, the W/T aerials being strung from the tripod foremast to a braced ensign staff.

Despite the improved angles of elevation on the main battery, the primary AA weapon was still the quadruple 2-pdr 'pompom'. Sited abaft the funnel, it had a better field of fire than on the preceding two-funnelled ships yet still had a wide blind sector forward. As in most British destroyers, there was a constant struggle to keep topweight within acceptable bounds.

Eight **'J' class** and eight identical **'K' class** destroyers were ordered in 1937, followed by eight similar **'N' class** ships in 1939 (the 'L' and 'M' classes already being under construction). Of the total of 24 ships, no less than 13 were sunk, eight significantly to aircraft.

Five of the 'N' class were Australian-manned, two Dutch and one Polish. They were of remarkably tough construction: HMS ***Javelin***, for instance, survived both a major collision and, at a later date, being parted from both bow and stern sections by a salvo of enemy torpedoes. The saga of the leader HMS ***Kelly*** is related elsewhere, and the other units were HMS ***Jervis*** (leader), HMS ***Jackal***, HMS ***Jaguar***, HMS ***Janus***, HMS ***Jersey***, HMS ***Juno***, HMS ***Jupiter***, HMS ***Kandahar***, HMS ***Kashmir***, HMS ***Kelvin***, HMS ***Khartoum***, HMS ***Kimberley***, HMS ***Kingston***, HMS ***Kipling***, HMS ***Napier*** (leader), HMS ***Nerissa***, HMS ***Nestor***, HMS ***Nizam***, HMS ***Noble***, HMS ***Nonpareil***, HMS ***Norman*** and HMS ***Nepal***.

HMS* Javelin *rejoins her flotilla after a special mission. Although severely damaged on more than one occasion,* Javelin *was one of only two 'J' class to survive the war. Altogether 13 of 24 'J', 'K' and 'N' class were lost.

Specificiation

'J', 'K' and 'N' classes (as built)
Displacement: 1,690 (leaders 1,695) tons standard and 2,330 tons full load
Dimensions: length 108.66 m (356.5 ft); beam 10.87 m (35.66 ft); draught 2.74 m (9 ft)
Propulsion: two sets of geared steam turbines delivering 29828 kW (40,000 shp) to two shafts
Performance: maximum speed 36 kts; endurance 10139 km (6,300 miles) at 15 kts
Armament: three twin 119.4-mm (4.7-in) and one quadruple 2-pdr 'pompom' guns, and two quintuple 533-mm (21-in) torpedo tube mountings
Complement: 183

The *Kelly* in Action

HMS* Kelly *caught the public imagination in a way that few other ships or ship's companies did. It would be as well to examine the record of such a vessel, no more or less worthy than many other destroyers, in order to discover the tremendous strain on both men and machinery that was inflicted by the bitter struggles of the war at sea.

Many destroyers achieved more than HMS *Kelly*, and certainly the great majority had longer careers, yet this ship (whose lifespan was precisely 21 months from handing-over to sinking) had an uncanny knack of being where trouble was, and was seldom out of the public eye.

With the 'Tribals' widely criticized as being too large and too expensive, the 16 'J' and 'K' class ships were slimmed down, with more of the traditional emphasis on torpedoes and less on guns. The classes were ordered in March and April 1937 for delivery by July 1939, an urgent schedule that reflected the growing certainty of war, and was possible only by the involvement of eight separate shipyards.

Both leaders went to the 'Geordie' yard of Hawthorn Leslie. As was the custom both were named after notable commanders but, where the 'J' class destroyer leader took the historically renowned name *Jervis*, the 'K' class leader took the name *Kelly*, after Admiral of the Fleet Sir John Kelly, one-time commander-in-chief of the Atlantic Fleet, who had died in 1936. This was something of a precedent and the name has never been repeated, but the ship acquired her dashing reputation from the bravura personality of her first (and only) captain, Lord Louis Mountbatten. He commissioned the ship as leader of the 5th Destroyer Flotilla in August 1939, and she was still working up at Portland when war was declared. The first warlike task was to turn-to, captain included, and cover the glossy perfection of the peacetime paintwork with the drab, matt grey known to generations of brush-wielding sailors as 'Crabfat'. The very next day a (probably imagined) periscope was roundly depth charged in Weymouth Bay. War had commenced.

A week later the *Kelly* did a high-speed return dash to Le Havre to pick up the Duke and Duchess of Windsor from French exile and to bring them to Portsmouth. She immediately proceeded to Plymouth, and within days was at sea on the melancholy task of rescuing survivors of the sunken carrier HMS *Courageous*. A couple of months of regulation misery were then spent working out of Scapa before a welcome return to the Tyne for a spell of rest. This was interrupted by an emergency call from a mined tanker but, in going alongside, the *Kelly* touched off another mine, suffering considerable damage aft. She re-entered the Tyne at the end of a tow line and spent two months in drydock. Emerging in February 1940 she returned to Scapa but, shortly after this and while escorting a convoy, she ran foul of the larger HMS *Gurkha* in a snowstorm. The glancing collision caused damage sufficient to put the *Kelly* in dock again, this time on the Thames.

She was repaired in time for the end of the unhappy military campaign in Norway.

Dive-bomb attack

As one of six destroyers, *Kelly* proceeded to Namsos to evacuate an Anglo-French force, but they were heavily dive-bombed on 3 May, losing both HMS *Afridi* and the French *Bison*. Destroyers were already proving vulnerable to this form of attack.

Only a week later, Germany invaded the Low Countries and the cruiser HMS *Birmingham* sailed to intercept an enemy minelaying force reported west of the Kattegat. Of the seven destroyers in company two, the *Kelly* and HMS *Kandahar*, were detached to investigate a reported U-boat contact. This proved unprofitable and, joined by the older HMS *Bulldog*, the destroyers made after the main force. Darkness had fallen when suddenly, totally without warning, a torpedo knifed into the *Kelly*'s port side. It struck right at the ship's weak spot, the adjacent boiler spaces. In a roaring cloud of live steam the destroyer ground to a halt, the forward boiler room open to the sea with a 15-m (50-ft) gap stretching from keel to waterline. Grinding ominously in the lumpy sea, the ships' longitudinal framing held her together. She settled to starboard but, once the adjacent bulkheads had been thoroughly shored, showed no immediate signs of sinking. The *Bulldog* came alongside and passed a tow line with the *Kelly*, once moving, using emergency steering to reduce her tendency to yaw while the crew worked feverishly to heave overboard all movable topweight.

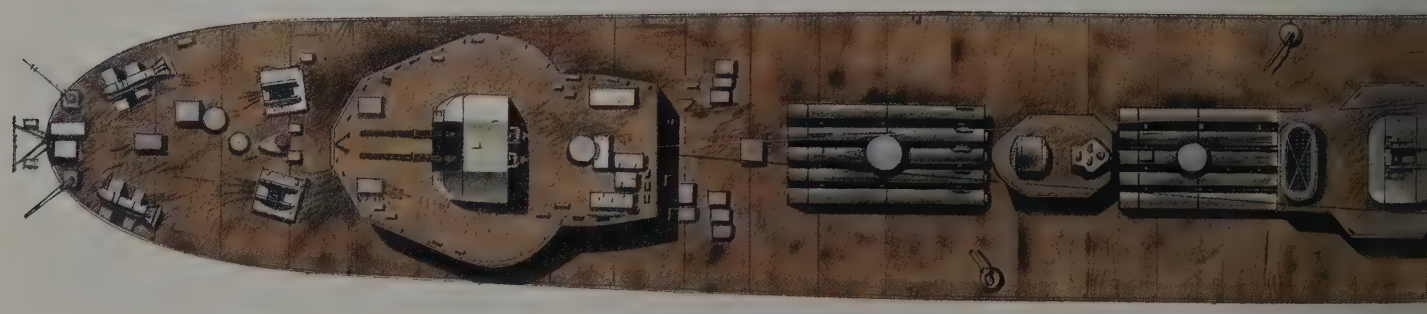
While there had, as yet, been no clue as to the origin of the torpedo (it had actually been fired by *S.31*, one of four 'E-boats' in the area), the mystery was resolved about midnight when another boat, seeking to find and finish off the cripple, came roaring out of the night at high speed. It sideswiped the labouring *Bulldog* and raked down the length of the *Kelly*'s starboard side, which was nearly level with the water; davits, boats and guardrails were exchanged for shattered timber as the boat careered along the destroyer before disappearing into the gloom as suddenly as it had arrived. Not a shot had been fired.

Throughout the following day the slow procession continued with a changed escort. The *Kelly*'s sorely-tried bulkheads were leaking; with no power to operate pumps, she was slowly settling and unnecessary crew were taken off. The arrival of a tug speeded things up and eventually, with only a skeleton crew headed by Mountbatten, the weary flotilla sighted the Tyne piers. It had taken nearly four days.

The Fifth Destroyer Flotilla is seen at sea with HMS* Kashmir *and* Kelly *in view.* Kelly, *distinguishable by the dark band around her funnel top, was fitted as a destroyer leader, and her extra command facility made her marginally heavier.

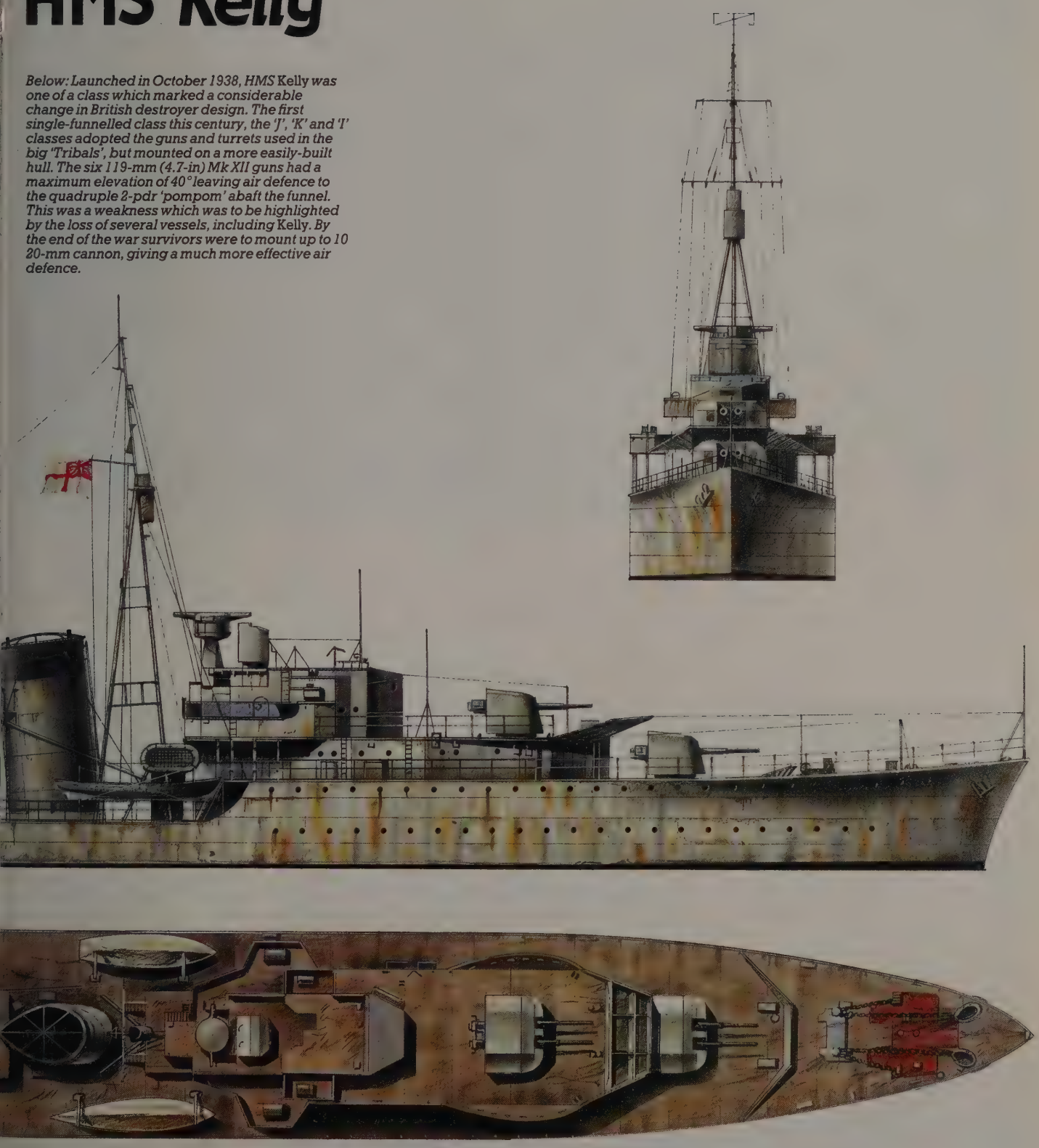
The *Kelly* in Action

Above: Kelly, *passing a message by line, clearly shows the limited field of fire forward for the quadruple 'pompom' that was the vessel's main anti-aircraft defence.*



'K' Class Destroyer Leader HMS *Kelly*

Below: Launched in October 1938, HMS Kelly *was one of a class which marked a considerable change in British destroyer design. The first single-funnelled class this century, the 'J', 'K' and 'L' classes adopted the guns and turrets used in the big 'Tribals', but mounted on a more easily-built hull. The six 119-mm (4.7-in) Mk XII guns had a maximum elevation of 40° leaving air defence to the quadruple 2-pdr 'pompom' abaft the funnel. This was a weakness which was to be highlighted by the loss of several vessels, including* Kelly. *By the end of the war survivors were to mount up to 10 20-mm cannon, giving a much more effective air defence.*



Kelly *returns to action after being torpedoed by the German* Schnellboote S.31. *The six months in her builders' hands had made her ready once again, but action around the beleaguered island of Malta was soon to lead to her final battle.*

Again she entered her builder's dock, 27 of her crew were buried and the Tynesiders got down to a virtual rebuild.

It was December before Mountbatten again commissioned her. In the meantime he had led the 5th Destroyer Flotilla from HMS *Javelin*. True to form, he tangled with four German destroyers off Plymouth on 28-29 November 1940, and two torpedoes from a salvo neatly removed both bow and stern of his ship. To the *Javelin*, as to the *Kelly* before, came the enquiry 'Is Captain (D) alive?' and back went the same reply 'Yes, you are not in command of the Flotilla yet.'

Spring 1941 found a newly worked-up *Kelly* and her flotilla at Plymouth. Life was eternally busy but without major event until, in April, they were ordered to Malta. Existence in the Mediterranean was, at that time, precarious: the Greek campaign had collapsed and, at considerable cost, the navy was evacuating 50,000 troops to Crete. With the Sicilian-based Luftwaffe reducing Malta slowly to dust and enemy land forces tightening their grip on the significant islands in the Aegean, the future of both Crete and Malta was looking less than bright.

Smaller naval units were still working out of Valletta, and the 5th Destroyer Flotilla formed part of the Malta striking force, Force K, that nightly contested enemy efforts at convoying supplies from Italy to his armies in North Africa. Returning from one of these sweeps on 2 May, the *Kelly* saw her sister destroyer HMS *Jersey* mined at the entrance to the Grand Harbour; she was brought in, but was a constructive total loss.

From the middle of May it was apparent that Crete's time had come. The Royal Navy patrolled in sufficient force to deter a landing by sea, but with superiority in every other department the enemy chose to come by air. His paratroops fought fanatically with nowhere to retreat, but every available warship was at sea to prevent reinforcements arriving. On consecutive nights 5th Destroyer Flotilla ships slaughtered virtually helpless convoys of caiques, but by day the Luftwaffe was supreme. On 21 May HMS *Juno* disappeared within two minutes of taking a heavy bomb. Next day it was the turn of HMS *Greyhound*, together with the cruisers HMS *Fiji* and HMS *Gloucester*, who had fought until their AA ammunition was exhausted.

Maleme bombardment

On the same grim day the *Kelly* arrived from Malta, accompanied by HMS *Kashmir*, HMS *Kelvin*, HMS *Kipling* and HMS *Jackal*. Together with the *Kashmir* and *Kipling*, she was directed to bombard Maleme airfield after dark. Though the last named fell out as a result of mechanical trouble, the operation began well with the interception and destruction of a pair of heavily-loaded caiques. Unfortunately the short, late-spring night was nearly spent by the time the British ships' mission was done.

With the main strength of the fleet recalled earlier to Alexandria, they were on their own. Dawn found them barely clear of the island but an early high-level bombing was easily evaded. This attack was, however, closely followed-up by the dreaded dive-bombers: 24 Ju 87s of 1 Stukageschwader, operating from airfields only minutes away in the Peloponnese, approached from astern. Both ships manoeuvred violently, with 2-pdrs, 12.7-mm (0.5-in) machine-guns, 20-mm cannon and even the 119.4-mm (4.7-in) guns on opportunity throwing everything at an enemy who attacked from all quarters. Within minutes the *Kashmir* was broken-backed, her smoke-shrouded hulk barely losing its way before it was the *Kelly*'s turn. Turning at full speed, she was heeling when squarely hit aft of amidships. Such was the impact that she did not recover, rolling over onto her beam ends and then capsizing completely to port, hanging thus for a long 30 minutes with many of her crew trapped inside before sliding under in 1,500 fathoms.

Fortunately, the *Kipling* had overcome her mechanical problems and was close enough to pick up a total of 279 survivors. To the discredit of the enemy, she was heavily bombed and strafed throughout, several men being killed. Still under attack, she withdrew and successfully reached Alexandria the next day.

The loss of the ships emphasized the varying fortunes of the war at sea, for they had been sunk south of Gavdo Island in the same spot that saw, less than two months earlier, the opening skirmish of the Battle of Matapan. The very next day, 24 May, saw the fleet stunned by the news of the loss of HMS *Hood*, far from the warmth of the Mediterranean she knew so well. There were to be many more such reverses before final victory was achieved.

UK

'O' to 'Z' class destroyers

HMS Saumarez *is shown as she was while escorting Arctic convoys in 1943. Present at D-Day, she led Destroyer Flotilla 26 in the* Haguro *action, and was mined by Albania in the Corfu Channel in the year after the war.*

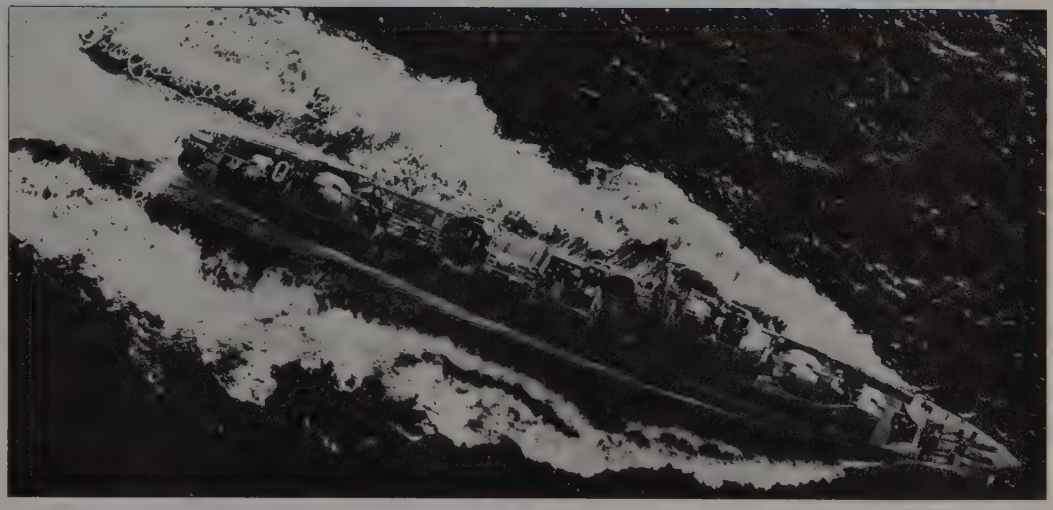
War emergency programmes produced 112 fleet destroyers, but only through a great degree of standardization and reduction of minimum peacetime standards. Two so-called 'intermediate' classes, the **'O' class** and **'P' class**, came first, with eight units apiece. These were 1,540-tonners which were influenced by the thinking that produced the 'Hunt' class escort destroyers, being for the most part armed only with 102-mm (4-in) guns. As the modern twin HA mountings were not immediately available, obsolete single mountings were used. Four of the 'O' class were fitted for minelaying, and war losses were five 'P' class ships.

With the **'Q' class** came the first of a long line of standard groups, whose 1,705-ton design was heavily based on the successful 'J' class with the latter's expensive and heavy twin 119.4-mm (4.7-in) gun mountings replaced by singles. Further savings in topweight were made by reverting to quadruple torpedo tubes. The return to the 119.4-mm (4.7-in) gun may have been decided by the growing availability of the excellent 20-mm Oerlikon. Of the eight units two became war losses.

As the 'Q' class was well received, the eight **'R' class** destroyers were almost identical except for the quartering of officers and crew both forward and aft. Though the arrangement was to facilitate coming to action stations irrespective of weather conditions, it was not judged to be successful. None of the class was lost.

With the **'S' class** (also eight ships) came a modification to the forward lines to reduce spray wetness that had produced complaint as far back as the 'J' class. They were also first with 40-mm Bofors guns and a full complement of Oerlikons, in addition to the main battery having an improved elevation for AA purposes. Two of the class were war losses.

Radar and other antennae proliferated to the point where the standard tripod mast was subject to severe stress and vibration so,with the eight-strong **'T' class**, the lattice mast was introduced; one 'V' class unit was lost. **'U', 'V'** and **'W' classes**, each of eight ships, followed to the same design, the eight-strong **'Z' class** then arriving with the 114.3-mm (4.5-in) gun, despite much expert opinion still favouring a more AA-orientated armament. Finally, came the four eight-ship groups of **'C' class** destroyers, with 'Ca', 'Ch', 'Cr', and 'Co' names. Many war emergencies were built of poor materials and had short lives, but others went on to be rebuilt into Type 15 and 16 frigates which acted as a link with frigate-dominated fleets of today.



HMS Zebra *in 1945. Developed from the 'J' class, with similar machinery in a smaller hull, the war emergency classes were produced in large numbers, and to a largely standard design. HMS* Zebra *was armed with the new 114-mm (4.5-in) gun.*

Specification

'Q' class (as built)
Displacement: 1,705 (leader 1,725) tons standard and 2,425 tons full load
Dimensions: 109.19 m (358.25 ft); beam 10.87 m (35.66 ft); draught 2.9 m (9.5 ft)
Propulsion: two sets of geared steam turbines delivering 29828 kW (40,000 shp) to two shafts
Performance: maximum speed 36.5 kts; endurance 8690 km (5,400 miles) at 20 kts
Armament: four single 119.4-mm (4.7-in), one quadruple 2-pdr 'pompom' and three twin 20-mm AA guns, and two quadruple 533-mm (21-in) torpedo tube mountings
Complement: 175

HMS Raider *is shown as part of the group of an escort carrier in East Indian waters in early 1945. Among the most stable of destroyers, the 'Q' and 'R' classes were the first to have a transom stern.* Raider *became INS* Rajput *in the Indian Navy, to which she transferred in 1949.*

UK

'Tribal' class destroyers

Quite unlike any previous British destroyer design, the 'Tribals' were an answer to heavily-armed contemporaries such as the Japanese 'Fubuki' class. Superb sea boats, the 'Tribals' were always in the thick of the action, losing 12 out of the 16 built.

Among the finest destroyers ever built for the Royal Navy, the 16 **'Tribal' class** ships appear, nevertheless, to have been produced as an answer to those being built by potential enemies rather than to fill any clearly identifiable role in the fleet. The long series of flotillas then culminating in the 'T' class had been armed with four single 119.4-mm (4.7-in) guns and, in order to uprate these to twin mountings, the 'Tribals' needed a 36 per cent increase in standard tonnage yet, despite having only one set of torpedo tubes, were also one-sixth longer. They were seen as gun-armed 'super-destroyers', and there was much disagreement over their correct classification. Indeed, one casting of the original design had provided for a fifth gunhouse on the forward side of the larger after deckhouse but this, fortunately, was abandoned in favour of a quadruple 'pom-pom'. Even so, five of their number were sunk by aircraft attack.

By any standards they were magnificent-looking ships, their nicely-balanced profile in harmony with the high-freeboard hull that was introduced to improve their fighting qualities in poor weather. Wartime modifications included the exchange of 'X' mounting for a more useful twin 102-mm (4-in) HA mounting, and the suppression of the mainmast to improve firing arcs. The class was launched in 1937, but only four of the 16 were still afloat at the end of 1942, and these all eventually received lattice masts that did nothing for their appearance.

'Tribals' were built also for the Royal Australian Navy (three ships) and Royal Canadian Navy (eight ships), and all saw a great deal of action. Notable exploits include the '*Altmark* incident', where HMS ***Cossack*** rescued a large number of British merchant seamen from inside Norwegian territorial waters just before the German invasion, and the harrying of the *Bismarck* by four 'Tribals' and a Polish destroyer for the whole night before her sinking. Of those lost, HMS ***Sikh*** and HMS *Zulu* were sunk when a commando raid near Tobruk went badly wrong, and HMS ***Punjabi***, sunk in collision with the battleship HMS *King George V*, seriously damaged the latter in turn when her full outfit of depth charges exploded. The other units were HMS ***Afridi***, HMS ***Ashanti***, HMS ***Bedouin***, HMS ***Eskimo***, HMS ***Gurkha***, HMS ***Mashona***, HMS ***Maori***, HMS ***Matabele***, HMS ***Mohawk***, HMS ***Nubian***, HMS ***Somali*** and HMS ***Tartar***.

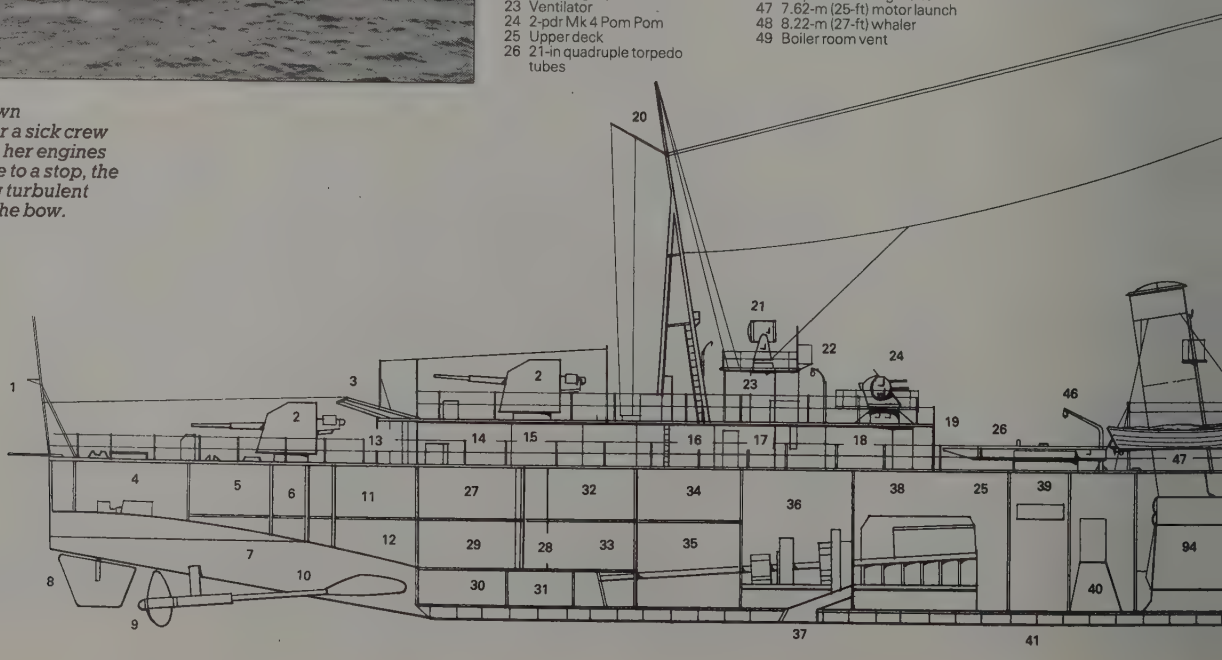
Specification

'Tribal' class (as built)
Displacement: 1,870 tons standard and 1,975 tons full load
Dimensions: length 115.1 m (377.5 ft); beam 11.13 m (36.5 ft); draught 2.74 m (9 ft)
Propulsion: two sets of geared steam turbines delivering 32811 kW (44,000 shp) to two shafts
Performance: maximum speed 36 kts; endurance 10541 km (6,550 miles) at 15 kts
Armament: four twin 119.4-mm (4.7-in) and one quadruple 2-pdr 'pompom' guns, and one quadruple 533-mm (21-in) torpedo tube mounting
Complement: 190

Above: HMS Zulu *is shown manoeuvring to transfer a sick crew member at sea. She has her engines full astern and has come to a stop, the racing screws thrusting turbulent water forward toward the bow.*

'Tribal' class (1940) cutaway drawing key

1 Aft navigation light
2 Twin 119-mm (4.7-in) guns
3 Blast screen
4 Steering compartment
5 Provision room
6 Ammunition hoist
7 Waterline
8 Balanced rudder
9 Twin screws
10 Shaft
11 Wardroom
12 Store
13 CO's bathroom
14 CO's sleeping cabin
15 CO's day cabin
16 CO's pantry
17 Sick bay
18 Engineer's workshop
19 Aft superstructure deck
20 Mainmast
21 40-in searchlight
22 Searchlight platform
23 Ventilator
24 2-pdr Mk 4 Pom Pom
25 Upper deck
26 21-in quadruple torpedo tubes
27 Officers' cabins
28 Upper ammunition handling area
29 Gunner's office
30 Shell room
31 119-mm (4.7-in) magazine
32 Ship's office
33 Torpedo store
34 Engineer officer's cabin
35 Oil fuel tanks
36 Gearing room
37 Main circulating inlet
38 Engine room
39 Torpedo tube turntable machinery space
40 Reserve feed tanks
41 Double bottom
42 No. 1 boiler room
43 No. 2 boiler room
44 No. 3 boiler room
45 Funnel casing
46 Torpedo handling crane
47 7.62-m (25-ft) motor launch
48 8.22-m (27-ft) whaler
49 Boiler room vent
50 Wireless aerials
51 Foremast
52 Spotting top/lookout
53 Combined RF and AA control
54 Director control
55 Bridge
56 Compass platform
57 Signal platform
58 20-in searchlight
59 Pom-Pom director
60 CO's sea cabin
61 Asdic room
62 Wheelhouse
63 Remote control station
64 Chart house
65 Drying room
66 Galley
67 PO's scullery
68 Engineer's office
69 Crew mess



Destroyer Developments of World War 11

Where virtually all Allied destroyers at the beginning of the war were cast in the traditional gun/torpedo mould the various theatres soon forced evolutionary changes.

In the North Atlantic, the British used older destroyers extensively on convoy escort duty. For this their gun and torpedo armament was far too comprehensive and was reduced in favour of better means of stowing and delivering depth charges on a scale unconsidered in peacetime. Most had been fitted with asdic (later called sonar), but the performance of this system had been overestimated. Its limitations were a narrow beam and an inability to cope with the initial German submarine tactic of night attacks on the surface. The first was gradually overcome by the development of ahead-throwing weapons such as the Hedgehog and later the Squid, and the latter by the introduction of radar.

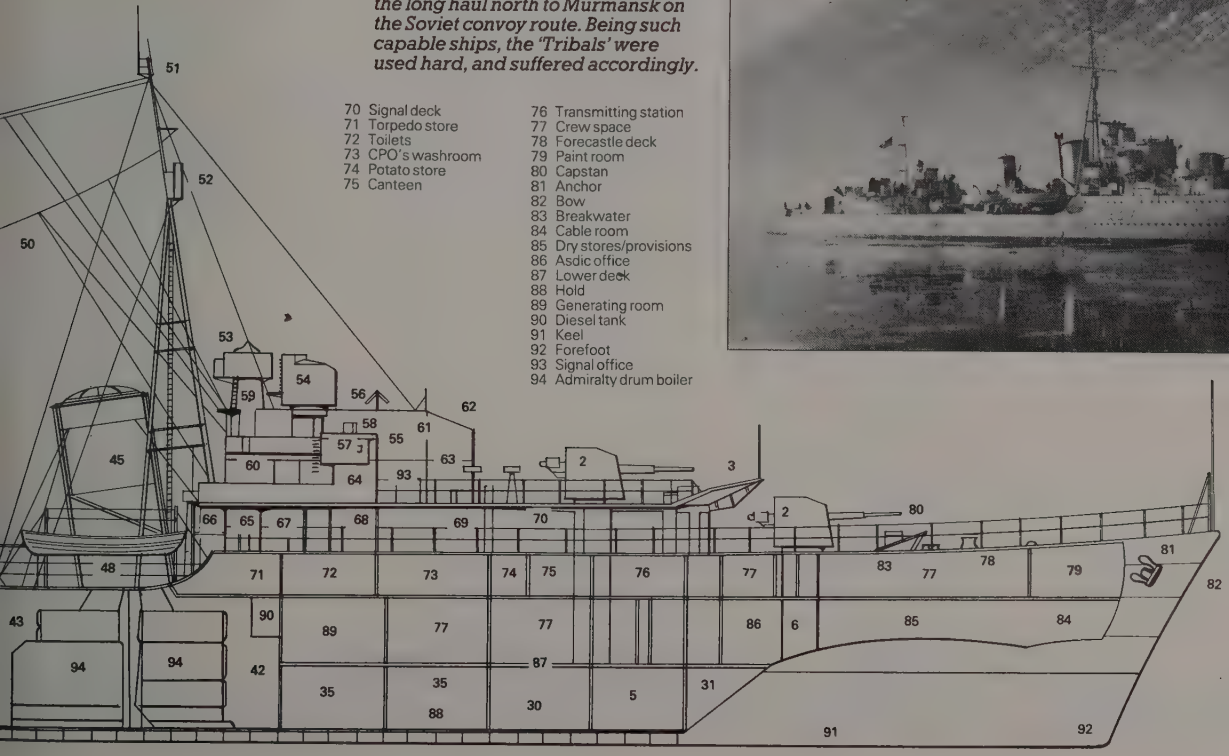
Designed for optimum performance over comparatively short periods at high speeds, these destroyers were overpowered for convoy duty and suffered from poor endurance. Some exchanged boiler capacity for extra bunkerage. All were lively and wet, failings which over several days fatigued a crew and reduced its efficiency. Their shortcomings on this essential duty were such as to promote the rapid development of specialist frigates, ships both cheap and capacious, fast enough yet long-legged, designed around a weapon and sensor fit that had largely to be drafted onto a destroyer.

In the Mediterranean, the British experience roughly paralleled that of the Americans in the Pacific. In these theatres the destroyer more often worked in conjunction with fleet concentrations of various sizes against other surface elements in the context of an ever-present threat from aircraft. For this, the standard armament was largely satisfactory and the pressure for change correspondingly less. All, but particularly the British, found themselves inadequately armed to meet air attack. At best they had a quadruple 2-pdr 'pompom', often machine-guns only. Initially, the main battery 119.4-mm (4.7-in) gun had elevations of only 30°, but even when later increased to 55° they could scarcely be regarded as dual-purpose weapons. Only with the 'Battle' and 'Weapon' classes did the Royal Navy get destroyers with true dual-purpose main armament and stabilized, radar-laid AA weapons capable of tackling the problem. By virtue of their production capacity, the Americans were able to supply and fit comprehensive batteries of 40-mm and 20-mm weapons long before the British. The clear arcs of fire required for these resulted in the suppression of all high fixtures abaft the funnels.

With the advent of the *kamikaze* came the need not only to shoot the aircraft down but also to disintegrate it, stimulating design of an automatic 76.2-mm (3-in) gun. This weapon was developed successfully, but too late to be of use in the war, destroyers receiving it in later updates. Another offshoot of the *kamikaze* menace was the need to detect approaching air strikes. Air surveillance radars were rapidly improved, altering the profile of the destroyers by the mounting of their heavy antennae on a lattice mast amidships. For maximum advance warning, these destroyers would be thrown forward as pickets and, themselves, became targets of an enemy intent on 'rolling back' the defence perimeter. The weight of a growing amount of gadgetry aloft became a major problem in some classes, which collected a considerable amount of ballast in the hull to counteract it, doing nothing for performance.

At sea, the war emergency general-purpose destroyer HMS* Onslow *contrasts strongly with the large pre-war fleet destroyer HMS* Ashanti. *War experience showed that these were far too heavily armed for most destroyer purposes, except in the vital area of anti-aircraft weaponry.

Right: HMS* Bedouin *leaves a lonely Iceland fjord in 1942, ready to make the long haul north to Murmansk on the Soviet convoy route. Being such capable ships, the 'Tribals' were used hard, and suffered accordingly.



UK

'Battle' class destroyer

As they served until the comparatively recent past, the **'Battle' class** destroyers may not be thought of as war-built but, in fact, they had their genesis about the time of Matapan when the Royal Navy was still desperately seeking ways of combatting the aerial threat so totally underestimated in the 1930s. Hard experience showed that the dive-bomber needed to be countered by plenty of metal yet, while the 'pompom' was an excellent weapon, main battery guns were capable of only 40° or 55° maximum elevation. The specification for the new destroyer called for 85° and a high rate of fire, the ship herself to be stabilized for higher accuracies and designed for rapid rudder response. By the time that the specification had been finalized there was also a Pacific war to be taken into account, together with the hard fact that the ships might not be completed in time to be of any use.

The overall result was a very large ship with considerable endurance and twinned gun houses, controversially both sited forward. A single 102-mm (4-in) gun was added abaft the stack but was really good for little more than firing illuminants. The large after structure supported two twin 40-mm mountings which had their own directors and were fully stabilized, so active fins were not, in the event, incorporated into the hull. A prominent feature was the Mk 6 'greenhouse' director control for the main armament, with the twin nacelles of the American-built Type 275 radar. Right aft, the initial large outfits of depth charges were soon superseded by the ahead-firing Squid mortar.

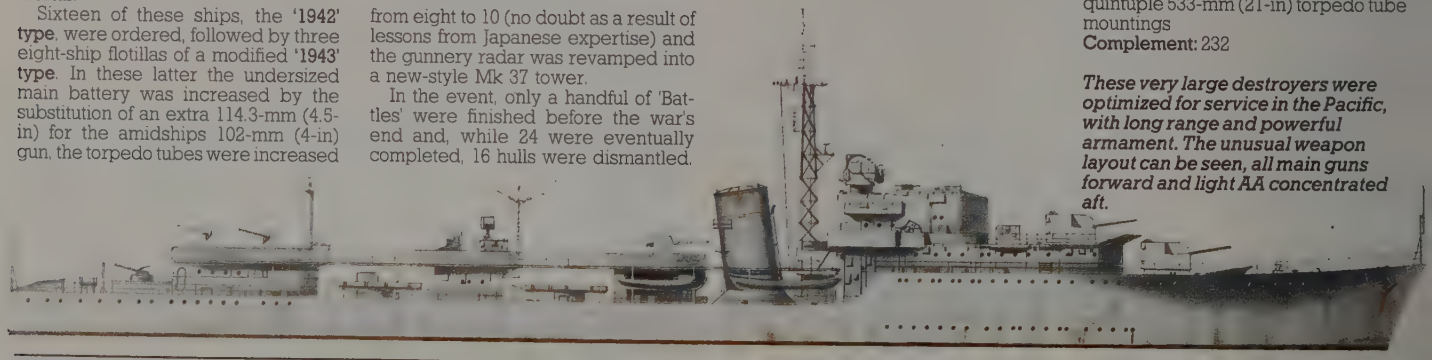
Sixteen of these ships, the **'1942' type**, were ordered, followed by three eight-ship flotillas of a modified **'1943' type**. In these latter the undersized main battery was increased by the substitution of an extra 114.3-mm (4.5-in) for the amidships 102-mm (4-in) gun, the torpedo tubes were increased from eight to 10 (no doubt as a result of lessons from Japanese expertise) and the gunnery radar was revamped into a new-style Mk 37 tower.

In the event, only a handful of 'Battles' were finished before the war's end and, while 24 were eventually completed, 16 hulls were dismantled.

Designed with the early lessons of the war very much in mind, the 'Battle' class destroyers were the first British destroyers to have a main armament of 85° elevation, together with radar direction. This gave a really effective anti-aircraft armament, when added to the six 40-mm weapons also mounted.

Specification
'Battle' (1943 type) class (as built)
Displacement: 2,380 tons standard and 3,290 tons full load
Dimensions: length 115.52 m (379 ft); beam 12.26 m (40.22 ft); draught 3.28 m (10.75 in)
Propulsion: two sets of geared steam turbines delivering 37285 kW (50,000 shp) to two shafts
Performance: maximum speed 35.5 kts; endurance 8047 km (5,000 miles) at 20 kts
Armament: two twin and one single 114.3-mm (4.5-in) DP plus two twin and two single 40-mm AA guns, and two quintuple 533-mm (21-in) torpedo tube mountings
Complement: 232

These very large destroyers were optimized for service in the Pacific, with long range and powerful armament. The unusual weapon layout can be seen, all main guns forward and light AA concentrated aft.



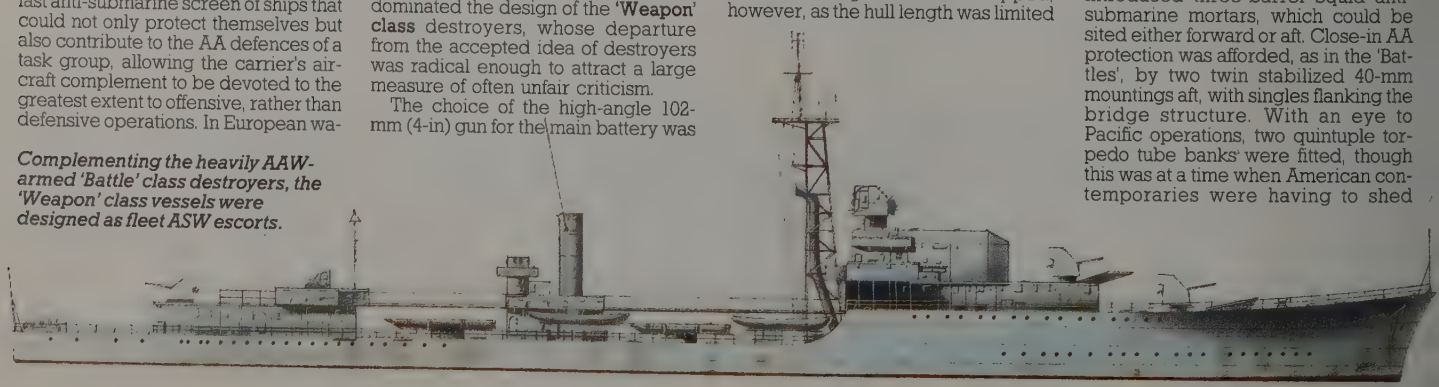
UK

'Weapon' class destroyer

Hard wartime experience had exposed the limitations of fleet destroyers as anti-submarine platforms. Nevertheless, the fleet still required a fast anti-submarine screen of ships that could not only protect themselves but also contribute to the AA defences of a task group, allowing the carrier's aircraft complement to be devoted to the greatest extent to offensive, rather than defensive operations. In European waters a full outfit of torpedo tubes had become superfluous, but this was not yet true of the Far Eastern theatre. It was these changed priorities which dominated the design of the **'Weapon' class** destroyers, whose departure from the accepted idea of destroyers was radical enough to attract a large measure of often unfair criticism.

The choice of the high-angle 102-mm (4-in) gun for the main battery was logical, its 14-kg (31-lb) projectile enabling fast hand-working even up to the maximum elevation of 80°. Only two twin mountings could be shipped, however, as the hull length was limited by available building berths. A third planned mounting was, therefore, abandoned in favour of the newly-introduced three-barrel Squid anti-submarine mortars, which could be sited either forward or aft. Close-in AA protection was afforded, as in the 'Battles', by two twin stabilized 40-mm mountings aft, with singles flanking the bridge structure. With an eye to Pacific operations, two quintuple torpedo tube banks were fitted, though this was at a time when American contemporaries were having to shed

Complementing the heavily AAW-armed 'Battle' class destroyers, the 'Weapon' class vessels were designed as fleet ASW escorts.



tubes in favour of enhanced AA armament. In a torpedo attack against surface targets, unsupported 'Weapons' would have suffered badly with their small-calibre main battery, and to redress this deficiency, a follow-on **'G' class** of eight ships was planned, largely similar but with twin 114.3-mm (4.5-in) dual-purpose mountings. Like all but four of the 20 'Weapons', however, the end of hostilities saw them cancelled. The four completed ships were HMS ***Battleaxe***, HMS ***Broadsword***, HMS ***Crossbow*** and HMS ***Scorpion***.

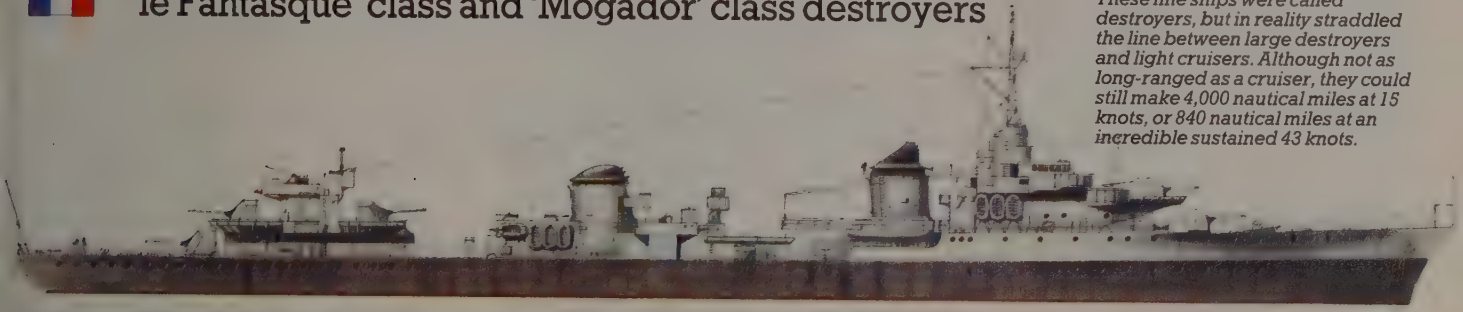
To improve damage control, the boiler and machinery spaces were sited alternately, requiring two funnels. It was the supporting of the forward funnel within the lattice foremast (copied also in the following 'Darings;) that appeared to particularly offend critics.

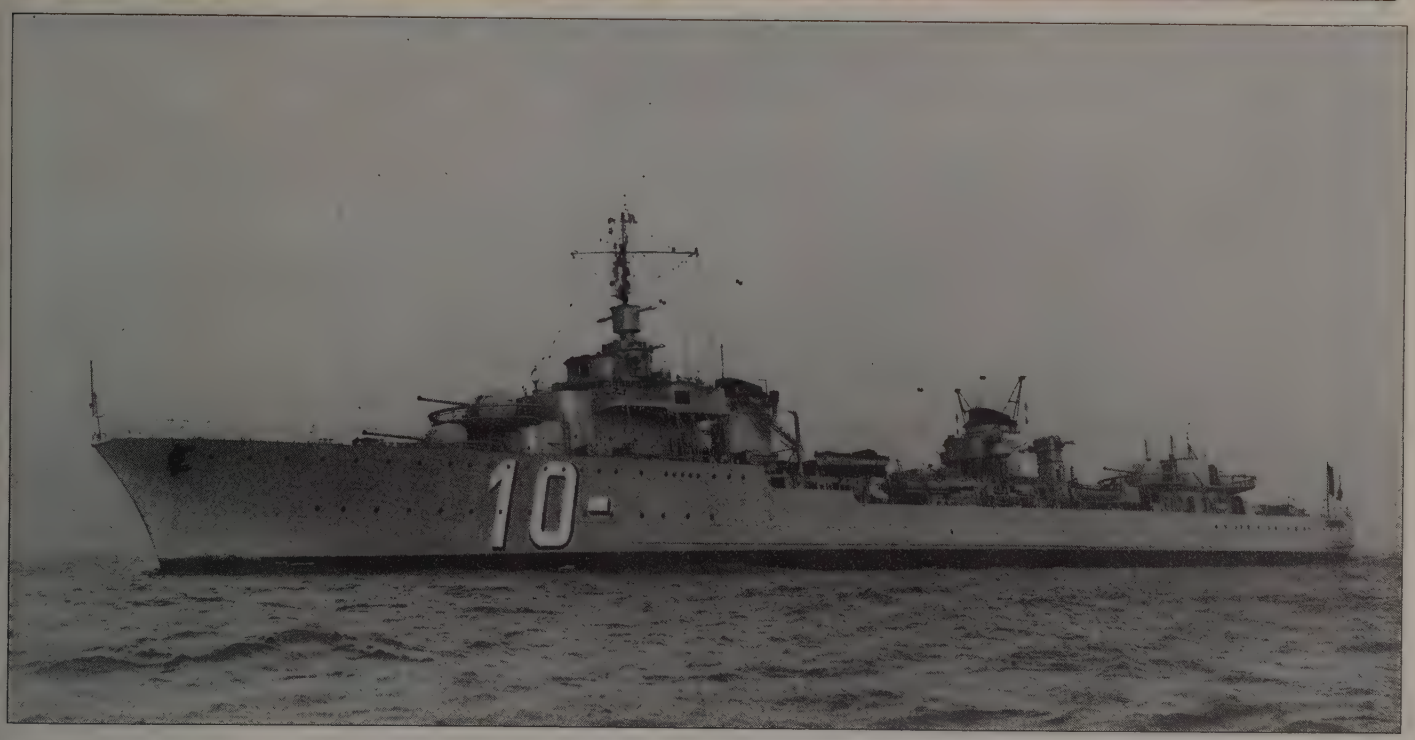
Specification
'Weapon' class (as built)
Displacement: 1,980 tons standard and 2,825 tons full load
Dimensions: length 111.2 m (365 ft); beam 11.58 m (38 ft); draught 3.2 m (10.5 ft)
Propulsion: two sets of geared steam turbines delivering 29828 kW (40,000 shp) to two shafts
Performance: maximum speed 35 kts
Armament: two twin 102-mm (4-in) DP plus two twin and two single 40-mm AA guns, and two quintuple 533-mm (21-in) torpedo tube mountings
Complement: 255

FRANCE

'le Fantasque' class and 'Mogador' class destroyers

These fine ships were called destroyers, but in reality straddled the line between large destroyers and light cruisers. Although not as long-ranged as a cruiser, they could still make 4,000 nautical miles at 15 knots, or 840 nautical miles at an incredible sustained 43 knots.





Le Fantasque *as she appeared after her 1939 refit. This fine-looking vessel typified the kind of 'super destroyer' arising out of Franco-Italian naval rivalry in the Mediterranean.*

The **'le Fantasque' class** was the penultimate class of a series that set new destroyer standards at the 'top end', yet which had little real influence on construction abroad as they stemmed largely from naval rivalry with the Italians.

It was with the three 'Leone' class ships of 1921-2 that the Italians first stimulated the French, who replied with the six **'Chacal' class** destroyers, significantly with similar names. The already impressive 37285 kW (50,000 shp) of these ships was increased to 47725 kW (64,000 shp) in the six **'Guépard' class** ships of 1927, the larger number of boilers producing also a superbly imposing four-funnel profile. The Italians answered with the 12 1,950-ton 'Navigatori' but, by the completion of these in 1931, the French had embarked on the 12-ship **'Aigle'class** and **'Vauquelin' class** group. It was from these that the 'le Fantasques' were derived: ***l'Audacieux, le Fantasque, le Malin, le Terrible, le Triomphant*** and ***l'Indomptable***.

These six destroyers were magnificent-looking ships with an imposing freeboard and an extra 3 m (9.84 ft) in overall length that allowed for a fifth gun and three triple sets of torpedo tubes. The four boilers were split into two pairs, separated by a machinery space and with a squat funnel exhausting each pair. Officially their installed power was 55182 kW (74,000 shp), but this would appear to have been exceeded by at least 10 per cent, for all could produce 43 kts on occasion and, more importantly, could maintain 37 kts in a seaway.

Only the two **'Mogador' class** destroyers pushed the specification further, their 137.4-m (451-ft) hulls carrying eight 138.6-mm (5.5-in) guns and 10 tubes. Although still very much super-destroyers in concept and appearance, they resulted directly in the Italian 'Capitani Romani' which, while having very similar major parameters, were more scout cruisers in approach.

Both latter groups of French destroyers were, in fact, later to be termed 'light cruisers' but their original label of *contretorpilleur* better defined their primary task in breaking up enemy destroyer attacks.

Half-a-dozen of them survived the wastage of war and, well modified, went on to serve the French fleet through to the 1950s.

Specification
'le Fantasque' class (as built)
Displacement: 2,570 tons standard and 3,350 tons full load
Dimensions: length 132.4 m (434.4 ft); beam 12.35 m (40.52 ft) draught 5.0 m (16.4 ft)
Propulsion: two sets of geared steam turbines delivering 55182 kW (74,000 shp) to two shafts
Performance: designed speed 37 kts
Armament: five single 138.6-mm (5.46-in) and two twin 37-mm AA guns, and three triple 550-mm (21.65-in) torpedo tube mountings
Complement: 210

Sink the *Haguro*!

On the face of it, one of the most powerful heavy cruisers ever built versus five small destroyers would be no contest – but in May 1945 reality proved very different.

At 16.40 local time on 10 May 1945, the British submarine HMS *Subtle* sighted a 'Nachi-class cruiser' with a destroyer and two smaller escorts in the narrows of the Malacca Strait, between Malaya and the island of Sumatra. They were proceeding north westward at about 17 kts but, though the *Subtle* and two sisters were in theory blocking the strait, a combination of shallow waters, fast tidal flow and zigzagging of the target conspired to defeat the submarines' efforts to close, and a sighting report was transmitted.

The *Subtle*'s report had been accurate, for the cruiser was the *Haguro* which, accompanied by the destroyer *Kamikaze* and two patrol ships, had left Singapore the day before, bound for Port Blair in the Andamans. Her mission was to evacuate the garrison. In the Pacific islands, this would probably have been undertaken by the 'Tokyo Express' or a Daihatsu barge service, but the Andamans lay a hard days' steaming over open sea.

On the strength of an earlier intelligence report a powerful Allied force had already left Colombo to intercept the *Haguro*. Under the command of Vice Admiral H.T.C. Walker, it included the battleships HMS *Queen Elizabeth* and the French *Richelieu*, the Dutch destroyer *Tromp* and four escort carriers. On the day following the *Subtle*'s report, however, this force was sighted by a Japanese reconnaissance aircraft and the alerted *Haguro* turned back, passing the British submarine line, the persistent *Subtle* getting a good depth charging from the *Kamikaze* for her trouble.

The *Haguro* then dawdled, awaiting the outcome of a planned airstrike on the British force. This did not materialize but, despite the British presence west of Sumatra, an escorted Japanese transport succeeded in running from Penang to the Nicobars only 320 km (200 miles) to the south of Port Blair. Encouraged, the *Haguro* set off again on 14 May and, with all but one of the submarines now withdrawn, entered the Andaman Sea unchallenged. Though suspecting the movement, Walker had no definite information and, in the early hours of 15 May, detached the 26th Destroyer Flotilla, under Captain Manley Power, to work along the *Haguro*'s estimated track pending an air search.

Power's ship was HMS *Saumarez*, and she was accompanied by four of her 'V' class sisters, HMS *Venus*, *Verulam*, *Virago* and *Volage*. Let off the leash, they were in sight of the northern tip of Sumatra by daybreak. An air search at this time by four Grumman Avengers found, not the *Haguro*, but the transport returning from the Nicobars. They attacked it unsuccessfully, following which two had to 'ditch'.

Still without a fix on his primary target, Power pressed on in the direction of the transport's reported position. At 10.41, however, came a signal from the commander-in-chief Ceylon to Walker, repeated to Power, to abandon the operation as the *Haguro* was no longer considered a threat to wider activities in the Bay of Bengal. A true destroyer man, Power decided that Ceylon could not be in full receipt of the facts and queried the signal. This was a time-consuming process involving the messages being relayed and, pending clarification, the 26th Destroyer Flotilla held its course.

This Nelsonian approach was vindicated when a further Avenger, in fixing the transport, sighted also the *Haguro* and her destroyer running north out of the strait at easy speed. Again she reversed course on being sighted but Power held on. The time was approaching noon and a dive-bombing attack by Avengers at near maximum range again had no effect. It was up to the destroyers.

In the early afternoon they doubled the northerly tip of Sumatra and entered the strait at 27 kts. The weather was hot and sunny with vast banks of tropical cumulus building ominously over the land. Throughout the afternoon reconnaissance reports told of the *Haguro*'s leisurely progress southwards, alert apparently only to air attack. Power needed to make contact before dark yet dared not attack his powerful opponent by day.

At 16.40 the five destroyers were reorganized onto a line of bearing with the *Saumarez* at the centre. This meant that, although in visual contact, they could search a broad swathe of the strait. The afternoon turned to short tropical dusk, the cloud moving off the land and the oncoming humid darkness becoming shot with flickers of lightning.

The face of the waters was increasingly lashed by heavy showers, ideal destroyer weather, particularly with the superior British gunnery radars.

At a relaxed state of readiness, the destroyers were steering roughly ESE with the *Venus* the most northerly ship, the remainder strung out on a line of bearing on her starboard bow. The thundery weather made for freak radar conditions and, at 22.40, the *Venus* detected a target at nearly 64-km (40-mile) range; it bore north east and a plot determined its course to be south east. It was the *Haguro* which, having abandoned the attempt to get to Port Blair, was making for Singapore.

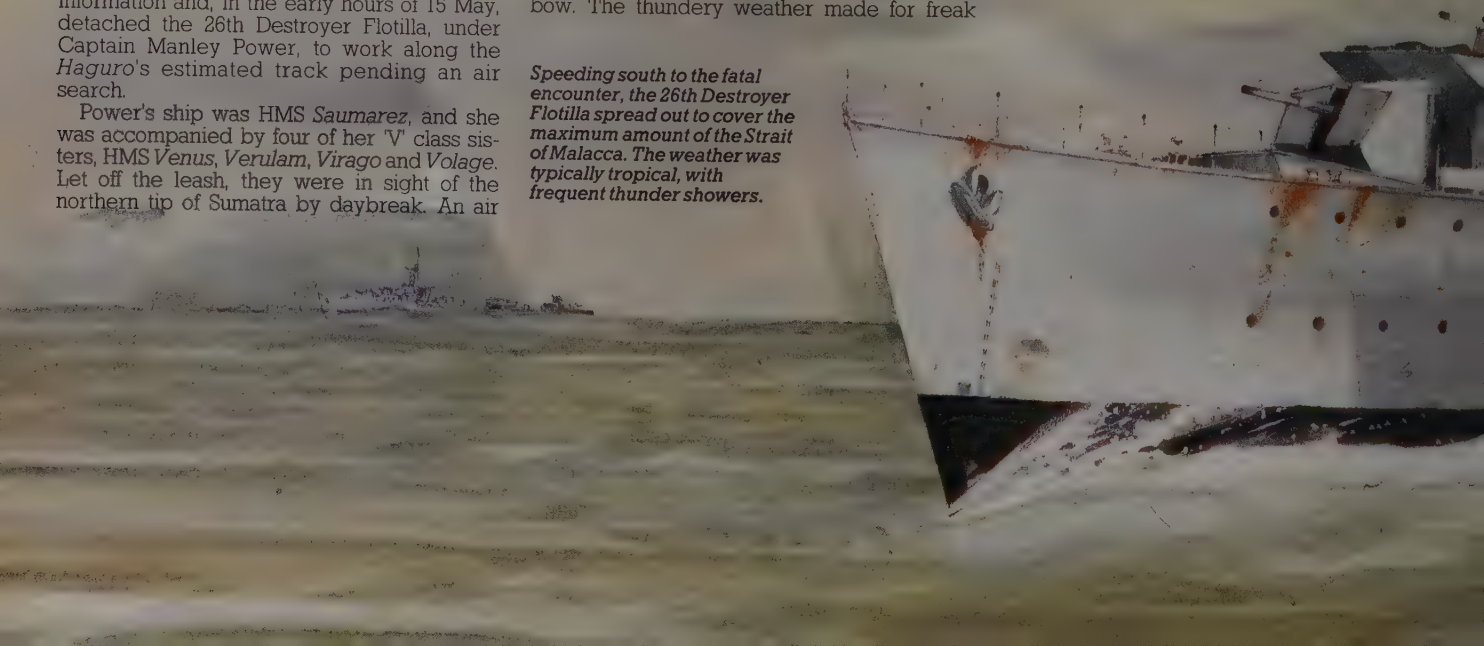
Power's tactics had been rehearsed on many earlier occasions and each commander knew what was expected of him.

The flotilla overtook its target, no more than 22.5 km (14 miles) wide to starboard of its track, then hooked to the northward in a curved line abeam, the aim being to pinpoint the target, envelop it and attack from each quarter.

Destroyers detected

At 00.45 on 16 May the *Haguro*, with the *Kamikaze* on her port quarter, was 16 km (10 miles) distant from the centre of the British line and closing when her radar detected the destroyers. She manoeuvred as if unsure of their identity (they were approaching from the unlikely direction of Singapore) but then, with sudden resolve, reversed course. At this stage only the *Venus* had worked behind the target and now found herself on its port bow. While Power's other destroyers bent on speed to overtake, the *Venus* crossed the *Haguro*'s bows to attack from a forward bearing to starboard, missed her chance and had to make a rapid 300° turn to port to disengage. The Japanese, however, apparently assumed that torpedoes had been launched and again reversed course but still without opening fire. Power's four destroyers were now closing through the velvet darkness at a relative speed of over 50 kts. Any misunderstandings were resolved as the *Saumarez* passed the *Kamikaze* on a reciprocal course and raked her at close range with both main armament and automatic fire.

It was just after 01.30 and both sides fired starshell. The *Saumarez* was bathed by the greenish glare at only 2745 m (3,000 yards) from the *Haguro*, which opened a brisk fire. The destroyer was soon hit in a boiler room but skidded round in a tight turn to port and launched a full outfit of torpedoes. Almost simultaneously the *Verulam* was attacking from the adjacent quadrant, unopposed as a result of the Japanese preoccupation with the *Saumarez*.



Speeding south to the fatal encounter, the 26th Destroyer Flotilla spread out to cover the maximum amount of the Strait of Malacca. The weather was typically tropical, with frequent thunder showers.

The now violently manoeuvring cruiser was hit forward by three torpedoes. Her forward armament went silent and she began to list, only to be hit by one, possibly two, further torpedoes in the machinery spaces.

For 10 minutes the *Haguro* was teased by destroyer gunfire from various directions until, seizing their chance, the *Venus* and *Virago* ran in from both starboard quadrants, launching 11 torpedoes between them. There were three likely hits but the return fire was now only sporadic and under local control. On the *Haguro*'s bridge most of her senior officers lay slaughtered by a direct hit from a 119.4-mm (4.7-in) shell.

Only the *Volage* had now not attacked, and was directed at 01.50 to finish off the hulk of the cruiser now lying deep, listing and burning aft. At a range of only 1.6 km (1 mile), every torpedo missed and it fell to the *Venus* with just two remaining to sink her. At 02.06 the *Haguro* went down, some 72 km (45 miles) south west of Penang.

The jubilant destroyers retired almost immediately, but the *Kamikaze* later returned to retrieve 400 survivors from the dark waters. Of the British flotilla only *Saumarez* had been damaged, suffering two dead. In the words of Admiral Lord Mountbatten, the supreme commander in South East Asia, it had been 'an outstanding example of a night attack by destroyers'.

Hit by three torpedoes, Haguro *began to list and burn, further hits making central fire control impossible and so making it difficult to fight effectively. Handicapped in this way,* Haguro *had little chance against so many fast-moving targets. Only 30 or so minutes after the first starshell was fired,* Haguro *was sunk.*

Captain Power in HMS Saumarez *had worked his flotilla through exercises enabling them to deal flexibly with any occasion. His main aim was to ensure contact at night, for a daylight engagement would hand the 203-mm (8-in) guns of* Haguro *an incalculable advantage.*

FRANCE

'Bourrasque' class, 'l'Adroit' class and 'le Hardi' class destroyers

Corresponding to British fleet destroyers, the French *torpilleurs d'escadre* ranked between the light 'Mediterranean' boats and the super destroyers. By 1940 there were 34 in commission, of three separate classes. Of these the 1,320-ton **'Bourrasque' class** dated from the 1922 programme. Named after winds, these 12 ships had an unusual funnel arrangement, one for each of three boilers, unequally spaced and of unequal height as they had to be cut down as a stability measure soon after completion. Even so, with four 130-mm (5.1-in) guns and only six torpedo tubes, they were still quite modestly armed in comparison with, for example, a later American 'Gridley', which had 16 tubes on a hull of very similar dimensions. The ships were the ***Bourrasque, Cyclone, Mistral, Orage, Ouragan, Simoun, Sirocco, Tempête, Tornade, Tramontane, Trombe*** and ***Typhon***.

Even before the completion of the 'Bourrasques' in 1928, the first of 14 1,389-ton **'l'Adroit' class** destroyers were being constructed to an improved design. Marginally larger in both dimensions and displacement, slightly higher powered and faster, they retained the individual funnel arrangement. The ships were ***l'Adroit, l'Alcyon, Basque, Bordelais, Boulonnais, Brestois, Forbin, le Fortuné, Foudroyant, Fougueux, Frondeur, le Mars, la Palme*** and ***la Railleuse***.

Completion of this second group in 1931 was followed by a five-year 'holiday', construction being resumed with the planned 12-strong **'le Hardi' class**, though these were more scaled-down 'contretorpilleurs' than related to the 'l'Adroits'. Much larger at 1,770 tons standard, they carried half as many guns again in twinned mountings, more torpedo tubes and, more importantly, had improved endurance. The ships were the ***Casque, le Corsaire, Epée, le Flibustier, Fleuret, le Hardi, Lansquenet, Mameluck, l'Aventurier, l'Intrepide, l'Opiniâtre*** and ***le Téméraire***.

The pattern of losses among the medium-sized French destroyers reflected the divided nature of their country's loyalties. Of the 'Bourrasques', Dunkirk accounted for four, three more were lost when the British landed at Oran in 1942 and another was scuttled at Toulon. In the case of the 'l'Adroits', two were lost to German action at Dunkirk, four more through Allied action at Casablanca in 1942 and three were scuttled at Toulon. Of the 'le Hardis', only the leadship was ready in time to be of use, but was Vichy-manned at Dakar. Later units were completed by both the Germans and Italians, serving without much note.

Specification

'l'Adroit' class (as built)
Displacement: 1,378 tons standard and 1,900 tons full load
Dimensions: length 107.2 m (351.7 ft); beam 9.8 m (32.2 ft); draught 4.3 m (14.1 ft)
Propulsion: two sets of geared steam turbines delivering 24980 kW (33,500 shp) to two shafts
Performance: maximum speed 33 kts; endurance 2125 km (1,320 miles) at 15 kts
Armament: four single 130-mm (5.1-in) and one 75-mm (2.95-in) AA guns, and two triple 550-mm (21.65-in) torpedo tube mountings
Complement: 140

Improved versions of* Bourrasque, *the first French destroyer design after 1918,* l'Adroit *and her sisters were completed in the late 1920s. She was sunk off Dunkerque in May 1940.

THE NETHERLANDS

'Tromp' class destroyer

The ***Tromp*** and her sister ***Jacob van Heeinskerck*** of the **'Tromp' class** were interesting in being more 'pocket cruisers' than destroyers and demonstrates how, at the top of the size scale, the distinction between the two could be less than clear cut. They both possessed that quality of solid angularity that belied their small size and which was typical of Dutch practice. The French 'le Fantasques' were as large as the 'Tromps', but the latters' armament equalled that of the planned German *Spahkreuzer* (scout cruiser) concept; they were also designed to carry more torpedoes than many destroyers, but what really set them apart was their lack of speed. Even so, their excellent seakeeping enabled them to maintain their modest 32.5 kts long after 'faster' ships had been obliged to ease back.

The pair had true destroyer ancestry, being planned as leaders. Their design was enlarged, however, and welding and aluminium were employed extensively to save weight. An interesting reflection on their use in the vast Dutch East Indies was the incorporation of a Fokker seaplane and facilities. These would also have been included on the **'Callenburgh' class** destroyers had they ever been built as planned.

The *Tromp* was completed in August 1938, the same builders immediately laying down her sister. At the invasion of 1940 the latter came to the UK for completion with a very different armament. A stir was caused in British naval circles by the advanced Hazemeyer fire control for the AA armament; even the 150-mm (5.9-in) main battery could be elevated to 60°. Another interesting feature was light horizontal and vertical protection.

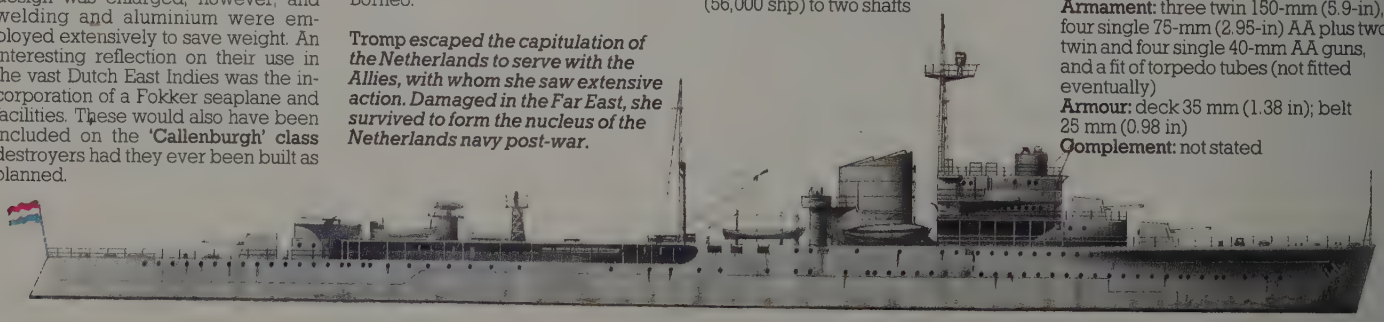
Though finding herself part of the hard pressed ABDA force at the opening of the war with Japan, the *Tromp* escaped after being extensively damaged disputing the invasion of Bali. She was sent to Australia for repairs, the lengthy nature of which were her salvation, for she re-entered service in time for the new Allied naval build-up in the Far East. During the counter-offensive she took part in operations against Sabang and Balikpapan in Borneo.

Tromp ***escaped the capitulation of the Netherlands to serve with the Allies, with whom she saw extensive action. Damaged in the Far East, she survived to form the nucleus of the Netherlands navy post-war.***

Specification

Tromp (as designed)
Displacement: 4,200 tons standard and 4,900 tons full load
Dimensions: length 131.91 m (432.78 ft); beam 12.41 m (40.72 ft); draught 5.41 m (17.75 ft)
Propulsion: two sets of geared steam turbines delivering 41759 kW (56,000 shp) to two shafts
Performance: maximum speed 32.5 kts
Armament: three twin 150-mm (5.9-in), four single 75-mm (2.95-in) AA plus two twin and four single 40-mm AA guns, and a fit of torpedo tubes (not fitted eventually)
Armour: deck 35 mm (1.38 in); belt 25 mm (0.98 in)
Complement: not stated

Seen in 1938,* Tromp *was an interesting design which could almost equally be called a light cruiser as a destroyer. Main armament of six 130-mm (5.9-in) guns also put her into the light cruiser class.



Royal Navy Part 4

The Royal Marines

The Royal Marines comprise a regular force of 7,700 officers and men with a reserve of a further 3,200. In 1984 the corps had the following units in service:

3rd Commando Brigade HQ
Nos 40, 42 and 45 Royal Marine Commando Groups
29th Commando Regiment, RA (with 18 105-mm/4.13-in Light Guns)
59th and 131st (TA) Commando Squadrons, RE
3rd Commando Brigade Air Squadron (with 12 Gazelle AH.Mk 1 and six TOW-equipped Lynx AH.Mk 1)
Commando Logistic Regiment
Special Boat Squadron
1st, 2nd (Reserve) and 3rd (Reserve) Raiding Squadrons
4th, 6th and 539th Assault Squadrons

Despite the disbanding of No. 41 Commando in 1981, the corps had a successful Falklands war, gaining much public and political acclaim. However, in several key areas the conflict also showed up operational deficiencies, notably the lack of any heavy 155-mm (6.1-in) artillery pieces for counter-battery and fortification-reduction work, and the absence of any organic Rapier SAM systems. The presence of a brigade armoured reconnaissance unit, even of only squadron strength, with Scorpion and Scimitar light tracked vehicles would also have been of considerable help. It is interesting to note that the comparable Soviet Naval Infantry force goes into battle with both medium and light tank support, 122-mm (4.8-in) self-propelled artillery, multiple rocket launchers and its own SAMs.

In wartime the Royal Marines will be aided by the Dutch 1st Amphibious Combat Group, which will provide units for use with the two mountain- and arctic warfare-trained Commandos on NATO's northern flank. Both marine corps will also provide units for operations in other NATO areas including (it is believed) the southern flank in support of Turkish and Greek forces. On the northern front the US Marine Corps will also provide units to fight south of the British and Dutch marines. Apart from these NATO roles, the Royal Marines also provide a world-wide amphibious assault capability for potential use by the British government in any trouble spot, the sea lift required for this role being provided by the Royal Navy and its amphibious warfare squadron centred on the two LPDs and the LSLs. How long this capability can be maintained is another moot point as the LPD's replacements must be ordered soon if continuity is to be maintained within the force.

The Royal Marines are a prime component of Britain's mobile warfare capability, ready for service in a wide variety of climates. Marines are seen here at training on Ascension Island prior to their fine performance in the Falkland Islands campaign.

Royal Navy order of battle

Major combat vessels and auxiliaries

Aircraft-carriers: *Invincible* (R05), *Illustrious* (R06), *Ark Royal* (R09, fitting out) and *Hermes* (R12, alongside training)

Ballistic missile submarines: *Renown* (S26), *Revenge* (S27), *Repulse* (S23) and *Resolution* (S22)

Fleet submarines: *Valiant* (S102), *Warspite* (S103), *Conqueror* (S48), *Courageous* (S50), *Churchill* (S46), *Superb* (S109), *Sovereign* (S108), *Swiftsure* (S126), *Sceptre* (S104), *Spartan* (S105), *Splendid* (S106), *Trafalgar* (S107), *Turbulent* (S110) and *Tireless* (S117), plus *Torbay, Talent, Tactician* and one unnamed building

Conventional submarines: *Orpheus* (S11), *Oberon* (S09), *Otter* (S15), *Oracle* (S16), *Ocelot* (S17), *Osiris* (S13), *Odin* (S10), *Onslaught* (S14), *Otus* (S18), *Opportune* (S20), *Onyx* (S21), *Olympus* (S12), *Opossum* (S19), *Sealion* (S07) and *Walrus* (S08), plus *Upholder* building and a further 9-11 'U' class planned

HMS Conqueror, a nuclear-powered fleet submarine, returns to port at the conclusion of a patrol. The 'Valiant' class has been in Royal Navy service for two decades, and is likely to remain so for some time alongside the 'Swiftsures' and 'Trafalgars'.

Assault ships: *Fearless* (L10) and *Intrepid* (L11)
Guided-missile destroyers: Type 82 *Bristol* (D23); 'County' class *Glamorgan* (D19) and *Fife* (D20); Type 42 Batch 1 *Birmingham* (D86), *Cardiff* (D108), *Glasgow* (D88) and *Newcastle* (D87); Type 42 Batch 2 *Exeter* (D89), *Southampton* (D90), *Nottingham* (D91) and *Liverpool* (D92); Type 42 Batch 3 *Manchester* (D95), *Gloucester* (D96), *York* (D98) and *Edinburgh* (D97)
Frigates: Type 21 *Amazon* (F169), *Active* (F171), *Ambuscade* (F172), *Arrow* (F173), *Alacrity* (F174) and *Avenger* (F185); Type 22 Batch 1 *Broadsword* (F88), *Battleaxe* (F89), *Brilliant* (F90) and *Brazen* (F91); Type 22 Batch 2 *Boxer* (F92), *Beaver* (F93) and *Brave* (F94), plus *London, Sheffield* and *Coventry* building; Type 22 Batch 3 *Cornwall* plus three others building
Ikara 'Leander': *Aurora* (F10), *Euryalus* (F15), *Galatea* (F18), *Arethusa* (F38), *Naiad* (F39), *Leander* (F109) and *Ajax* (F114)
Exocet 'Leander': *Minerva* (F45), *Danae* (F47) and *Penelope* (F127)
Training 'Leander': *Juno* (F52)
Exocet 'Leander' (Towed Array): *Cleopatra* (F28), *Sirius* (F40), *Phoebe* (F42) and *Argonaut* (F56)
Broad-beam 'Leander': *Achilles* (F12), *Diomede* (F16), *Apollo* (F70) and *Ariadne* (F72)
Seawolf 'Leander': *Andromeda* (F57), *Hermione* (F58), *Jupiter* (F60), *Scylla* (F71) and *Charybdis* (F75)
'Rothesay' class: *Rothesay* (F107), *Plymouth* (F126), *Yarmouth* (F101), *Lowestoft* (F103), *Berwick* (F115) and *Falmouth* (F113) (all to be deleted from 1985 onwards)
Type 12 Training: *Torquay* (F43, to be deleted 1985)
Ice patrol ship: *Endurance* (A171)
Royal yacht: *Britannia* (A00)
LSL: *Sir Bedivere* (L3004), *Sir Geraint* (L3027), *Sir Lancelot* (L3029), *Sir Percival* (L3036), *Sir Tristam* (L3505), *Sir Caradoc* (L3522) and *Sir Lamorak* (L3532)
Large fleet tankers: *Olwen* (A122), *Olna* (A123), *Olmeda* (A124) and *Tidespring* (A75)
Support tankers: *Appleleaf* (A79), *Brambleleaf* (AS81), *Bayleaf* (A109), *Orangeleaf* (chartered 1984) and *Pearleaf* (A77)
Small fleet tankers: *Green Rover* (A268), *Grey Rover* (A269), *Blue Rover* (A270), *Gold Rover* (A271) and *Black Rover* (A273)

Seen on active service in the South Atlantic, the large 'County' class guided missile destroyers will remain in Royal Navy service for several years, with the two survivors, HMS* Fife *and HMS* Glamorgan*, serving alongside HMS* Bristol *as flagships.

Replenishment ships: *Fort Grange* (A385), *Fort Austin* (A386), *Resource* (A480) and *Regent* (A486)
Aviation support ships: *Reliant* (A131) and *Engadine* (K08)
Seabed operations vessel: *Challenger* (K07)
Repair and maintenance vessel: *Diligence* (?)

Minor surface vessels

Patrol vessels: *Alderney, Anglesey, Guernsey, Jersey, Lindisfarne, Orkney, Shetland, Dumbarton Castle, Leeds Castle, Protector, Guardian, Sentinel, Peacock, Plover, Starling, Swallow, Swift, Kingfisher, Cygnet, Petrel* and *Sandpiper*
Minelayer/MCMV depot ship: *Abdiel*
Fleet minesweepers: 'River' class *Waveney, Carron, Helford, Dovey* and *Blackwater*, plus *Itchen, Helmsdale, Humber* and four unnamed building
Coastal minesweepers: 'Ton' class *Alfriston, Bickington, Crickton, Cuxton, Hodgeston, Pollington, Walkerton, Soberton* and *Stubbington*
Coastal minehunters: 'Ton' class *Bildeston, Brereton, Brinton, Bronington, Bossington, Gavinton, Hubberston, Iveston, Kedleston, Kellington, Kirkliston, Maxton, Nurton, Sheraton* and *Wilton*
MCMV: 'Hunt' class *Brecon, Ledbury, Cattistock, Cottesmore, Brocklesby, Middleton, Dulverton* and *Chiddingfold*, plus *Atherstone, Bicester* and *Hurworth* building with four others planned
Survey ships: *Herald, Hecla, Hydra* and *Hecate*
Coastal survey ships: *Fox, Fawn, Beagle* and *Bulldog*
Inshore survey ships: *Echo, Enterprise, Egeria* and *Gleaner.*

HMS* Cottesmore *is the fourth of a new class of GRP-hulled mine countermeasure vessels (MCMV). Current plans for the 'Hunt' class envisage a total of 14 vessels being constructed into the late 1980s.

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Modern Machine-Guns

An American soldier in Vietnam uses an M60 from an emplaced position, with plenty of ammunition belts ready to hand. In such belts about one round in six is tracer.

The use of automatic weapons steadily increased during World War II, and today most infantrymen carry weapons capable of burst fire. But the machine-gun remains the prime firepower component of the infantry squad, and classic designs like the Bren have lost none of their effectiveness.

The modern machine-gun is still one of the foot soldier's most powerful weapons, but it has changed much since World War I, when the machine-gun dominated the battlefields of France and elsewhere. Today's machine-gun is much lighter, more reliable and in general more flexible in its tactical applications. Most of the machine-guns here discussed are portable enough to be used in locations where it was once unthinkable that such weapons could even be carried, but they are still as lethal and efficient as they ever were.

The machine-gun is now in its second generation of development since World War II. The first generation weapons are still very much in evidence with virtually every armed force in the world, and are the post-war general-purpose machine-guns, or GPMGs. In the years after 1945 the GPMG was embraced by many as the way ahead in machine-gun design, but the soldiers in the front line discovered the hard way that the all-purpose machine-gun is as much a myth as the all-purpose truck. Thus the second generation of machine-guns is now entering service.

The second-generation weapons are more specialized than the GPMGs. The light machine-gun has made a come-back as the squad support weapon, while the heavy machine-gun has returned in the form of the post-war GPMGs retained for the heavy fire-support role. They are now in the position of either being retained indefinitely, or are slowly being replaced by the larger-calibre weapons such as the really heavy machine-guns (of 12.7/0.5-in calibre and upwards) or the machine weapons now generally known as cannon. It is the machine-guns that are covered in this study.

At first sight the variety of modern machine-guns looks somewhat bewildering, and the types mentioned here are but a selection of what is available. More types than can be covered in these pages are around or in the wings, for machine-gun development is still very progressive. Nearly all the major nations are either attempting to gild the lily by using the existing types, or alternatively chasing the myth of the perfect design. Some of the designs mentioned here do appear to have achieved near-perfection, for how otherwise can one contemplate the longevity of the MG3 and L4A4 Bren Gun designs? Others, such as the M60, make one wonder how they have lasted so long.

The most widely-used present-day version of the World War II Bren gun is the British L4A4, a conversion to standard NATO calibre. Seen here in action with the South African Army, it is also used by the British and many of the ex-Commonwealth armies, including India.

BELGIUM

7.62-mm FN MAG

World War II established the general-purpose machine-gun (GPMG) as a viable weapon with its ability to be fired from a light bipod in the assault role and from a heavy tripod in the defensive or sustained role. After 1945 many designers tried to produce their own version of the GPMG concept, and one of the best was produced in Belgium during the early 1950s. The company concerned was Fabrique Nationale or FN, based at Herstal, and its design became known as the **FN Mitrailleuse d'Appui Général** or **MAG**. It was not long before the MAG was adopted by many nations, and today it is one of the most widely-used of all modern machine-gun designs.

The MAG fires the standard NATO 7.62-mm (0.3-in) cartridge and uses a conventional gas-operated mechanism, in which gases tapped off from the barrel are used to drive the breech block and other components to the rear once a round has been fired. Where the FN MAG scores over many comparable designs is that the tapping-off point under the barrel incorporates a regulator device that allows the firer to control the amount of gas used and thus vary the fire rate to suit the ammunition and other variables. For the sustained-fire role the barrel can be changed easily and quickly.

In construction the MAG is very sturdy. Some use is made of steel pressings riveted together, but many components are machined from solid metal, making the weapon somewhat heavy for easy transport. But this structural strength enables the weapon to absorb all manner of rough use, and it can be used for long periods without maintenance other than changing the barrels when they get too hot. The ammunition is belt-fed, which can be awkward when the weapon has to be carried with lengths of ammunition belt left hanging from the feed and snagging on just about everything.

When used as an LMG the MAG uses a butt and simple bipod. When used as a sustained-fire weapon the butt is usually removed and the weapon is placed on a heavy tripod, usually with some form of buffering to absorb part of the recoil. However, the MAG can be adapted to a number of other mountings, and is often used as a co-axial weapon on armoured vehicles or as a vehicle defence weapon in a ball mounting, and as an anti-aircraft weapon on a tripod or vehicle-hatch mounting. It is also used on many light naval vessels.

The MAG has been widely produced under licence. One of the better-known nations is the UK, where the MAG is known as the **L7A2**. The British introduced some modifications of their own, (and have produced the weapon for export), and there is no sign of it being replaced in the foreseeable future as far as the British armed forces are concerned. Other nations that produce the MAG for their own use include Israel, South Africa, Singapore and Argentina, and there are others. Even longer is the list of MAG users: a brief summary includes Sweden, Ireland, Greece, Canada, New Zealand, the Netherlands and so on. There is little chance of the MAG falling out of fashion, and production continues all over the world.

The Belgian FN MAG is one of the most widely used of the post-World War II general-purpose machine-guns. Well made from what are usually solid metal billets machined to spec, the MAG is a very sturdy but heavy weapon that is still in production worldwide.

Specification

FN MAG
Calibre: 7.62 mm (0.3 in)
Weights: gun only 10.1 kg (22.27 lb); tripod 10.5 kg (23.15 lb); barrel 3 kg (6.6 lb)
Lengths: gun 1260 mm (49.61 in); barrel 545 mm (21.46 in)
Muzzle velocity: 840 m (2,756 ft) per second
Rate of fire: (cyclic) 600-1000 rpm
Type of feed: 50-round belt

Below: The FN MAG is licence-produced in Israel by Israel Military Industries and is used by all branches of the Israeli armed forces.

Above: During the Falkland Islands campaign L7A1s were hastily pressed into use on improvised anti-aircraft mountings to provide some measure of defence against Argentine attacks on the shipping in San Carlos harbour.

Below: The FN MAG is fitted to the turrets of the German Leopard 2 tanks in service with the Dutch army. Pictured here in September 1984 on Exercise 'Lionheart', the MAG has been fitted with a blank firing adaptor.

BELGIUM

FN 5.56-mm Minimi

With the turn away from the heavy NATO 7.62-mm (0.3-in) cartridge towards the smaller 5.56-mm (0.219-in) round for use by the standard rifles of most of the NATO nations (and many others), it followed that there was a need for a light machine-gun to use the new calibre. FN accordingly drew up the design of a new weapon that eventually became known as the **FN Minimi** and was first shown in 1974. The Minimi is intended for use only as a squad support weapon as there is no way that the light 5.56-mm cartridge can be used effectively for the heavy support or sustained-fire role, for it simply lacks the power to be effective at ranges much beyond 400 m (437 yards). Thus heavier-calibre weapons such as the FN MAG will still be retained for this role in the future.

The Minimi uses some design features from the earlier FN MAG, including the quick-change barrel and the gas regulator, but a new rotary locking device is used for the breech block which is guided inside the receiver by two guide rails to ensure a smooth travel. These latter innovations have made the Minimi into a remarkably reliable weapon, and further reliability has been introduced into the ammunition feed. This is one of the Minimi's major contributions to modern light machine-gun design as it does away with the long and awkward flapping ammunition belts used on many designs and which snag on everything when carried. The Minimi uses a simple box (under the gun body) which contains the neatly-folded belt. When the weapon is fired from a bipod, the box is so arranged that it will not interfere with normal use and on the move it is out of the way of the carrier. But the Minimi goes one step further: if required, the belt feed can be replaced by a magazine feed. FN has shrewdly guessed that the American M16A1 rifle would quickly become the standard weapon in its class, and has thus made provision for the Minimi to use the M16A1's 30-round magazine. This can clip into the receiver just under the belt feed guides after the belt has been removed.

The association with the American M16A1 rifle has turned out well for FN, for the Minimi has been adopted as the US Army's squad fire-support weapon, and is now known there as the **M249 Squad Automatic Weapon**, or **SAW**. This version will fire the new standard NATO SS109 5.56-mm cartridge rather than the earlier M193 cartridge. The SS109 has a longer and heavier bullet than the earlier cartridge and uses a different rifling in the barrel, but is otherwise similar to the American cartridge.

Two possible variants of the Minimi are a 'para' version which uses a shorter barrel and a sliding butt to make the weapon shorter overall, and a vehicle model with no butt at all for mounting in armoured vehicles. The Minimi itself has many ingenious detail points as well: the trigger guard may be removed to allow operation by a man wearing winter or NBC warfare gloves, the front handguard contains a cleaning kit, the ammunition feed box has a simple indicator to show how many rounds are left, and so on.

Overall the Minimi may be regarded as one of the best of the new family of 5.56-mm light machine-guns. It will be around for a very long time.

The FN Minimi has been adopted by the US Army for the Squad Automatic Weapon (SAW) as the M249. It is now entering service with the airborne divisions of the Rapid Deployment Joint Task Force (RDJTF).

Specification

FN Minimi
Calibre: 5.56 mm (0.219 in)
Weights: with bipod 6.5 kg (14.33 lb); with 200 rounds 9.7 kg (21.38 lb)
Lengths: weapon 1050 mm (41.34 in); barrel 465 mm (18.31 in)
Muzzle velocity: (SS 109) 915 m (3,002 ft) per second
Rate of fire: (cyclic) 750-1000 rpm
Type of feed: 100- or 200-round belt, or 30-round box magazine

CZECHOSLOVAKIA

7.62-mm vz 59

Czech machine-gun designers can trace their progeny back to the range of highly successful machine-guns started with the vz (*vzor*, or model) 26 in 1926 and which resulted in the famous Bren Guns. As successor to these designs the Czechs produced a new model during the early 1950s as the **vz 52**, which may be regarded as the old design updated to use an ammunition belt-feed system. This was not the success of the earlier weapons, and is now rarely encountered other than in the hands of 'freedom fighters' and the like, and the vz 52 has thus been superseded by the **vz 59**.

The vz 59 is much simpler than the earlier vz 52 but follows the same general lines in appearance and operation. In fact many of the operating principles of the vz 52 have been carried over, including the gas-operated mechanism. The ammunition feed system is also a carry-over from the vz 52, in which it was regarded by many as being the only successful feature. In this feed system the belt is carried into the receiver by guides where a cam system takes over and pushes the cartridge forward through the belt link into the weapon. This system was copied on the Soviet PK series, but on the vz 59 the belts are fed from metal boxes; for the light machine-gun role with the light barrel and designation **vz 59L**, one of these boxes can be hung from the right-hand side of the gun in a rather unbalanced fashion. The weapon may be used in the LMG role with bipod or tripod mountings.

For the heavy machine-gun role the vz 59 is fitted with a heavy barrel. In this form it is known merely as the vz 59. When fitted with a solenoid for firing in armoured vehicles on a coaxial or similar mount it is known as the **vz 59T**. This does not exhaust the variations of the vz 59 series for, no doubt with an eye to possible sales outside Czechoslovakia, there is a version that fires standard NATO 7.62-mm (0.3-in) ammunition and known as the **vz 59N**; the vz 59 series usually fires the Soviet 7.62-mm cartridge.

One rather unusual feature of the vz 59 is the telescopic sight, which can be used with the bipod and the tripod. This optical sight may be illuminated internally for use at night and is also used for anti-aircraft fire, for which role the vz 59 is placed on top of a tubular extension to the normal tripod.

To date the vz 59 is known to have been adopted only by the Czech army, although other nations may by now have the type in use. In the past Czech weapons have appeared wherever there is a market for small arms, and Czech weapons have thus recently turned up in the Middle East, and especially in Lebanon; some vz 52s have certainly been seen there. To date there is no record of any nation purchasing the NATO-ammunition version, but no doubt that version will turn up in some unexpected trouble spot one day.

Specification

vz 59
Calibre: 7.62 mm (0.3 in)
Weights: with bipod and light barrel 8.67 kg (19.1 lb); with tripod and heavy barrel 19.24 kg (42.42 lb)
Lengths: with light barrel 1116 mm (43.94 in); with heavy barrel 1215 mm (47.84 in); light barrel 593 mm (23.35 in); heavy barrel 693 mm (27.28 in)
Muzzle velocity: with light barrel 810 m (2,657 ft) per second, and with heavy barrel 830 m (2,723 ft) per second
Rate of fire: (cyclic) 700-800 rpm
Type of feed: 50- or 250-round belts

The Czech 7.62-mm (0.30-in) vz 59 is a development of the earlier vz 52/57, but much easier to produce. Developed with an eye to the international export market, the vz 59 has been adopted by the Czech armed forces but others crop up in various corners of the world.

Machine-Gun Tactics

The conflicting requirement for machine-guns to be portable yet capable of sustained fire led to the concept of the general-purpose machine-gun. However, in recent years the emphasis has been on specialization, heavy-barrel versions of rifles being introduced at squad level and sustained fire entrusted to such stalwarts as the Browning 0.50-calibre machine-gun.

During World War I the machine-gun was a weapon that could dominate the battlefield in a manner that made movement virtually impossible, and at times during that dreadful war machine-guns were often massed in batteries which rendered whole tracts of territory impassable to men and animals. Such a dominance was not to arise again, for in the wars that followed the static conditions of the Western Front arose only infrequently. The main dominance of the battlefield passed to the artillery and tanks, and only rarely were machine-guns able to reassert their former role. Instead the machine-gun took on a new role, that of fire support for troops in attack and defence. As warfare took on a more mobile and fluid form, the machine-gun was often able to pour such volumes of fire on attacking infantry or onto a position that the enemy's tactical movement or intention became temporarily difficult or impossible.

In these mobile and fluid conditions the machine-gun often became the pivot around which an infantry unit or squad could act. By moving to a flank, a machine-gun could keep an enemy's head down while the rest of the squad moved into a favourable position or made an attack. These tactics are still widely used, though the form of the machine-gun has changed.

By the end of World War I there were two types of machine-gun. The more widely used was the heavy machine-gun (HMG), which sat on a tripod and poured out volumes of fire. Then there was the lighter and more portable light machine-gun (LMG), which could be used at lower command levels than the ponderous heavy weapon. But by the end of World War II these two types had been joined by a third, the general-purpose machine-gun (GPMG). This was a German notion that caught on fast. Very basically the idea was that one weapon could be used for both the light and the heavy roles. The GPMG was air-cooled, and thus much lighter than the water-cooled, heavy machine-guns, and when used in the HMG role the GPMG simply overcame the problem of barrel heating (produced by large volumes of fire) by means of a rapid-barrel-change capability. Spare barrels could be held close at hand and fitted in a few seconds. The same weapon could be fitted with a light bipod for producing rapid aimed fire, and was thus capable of LMG use.

The first GPMGs were the German MG34 and MG42, the latter having the greater long-term influence to the extent that it is still in production. In the post-war period these two designs were soon joined by many others, and for a period it was GPMGs all the way. Economically the idea made good sense: only one weapon type would be needed, and with luck that basic type could be adapted for other roles outside the GPMG range, such as co-axial mountings for tank guns, helicopter guns and so on. Many of the post-war generation could indeed carry out these ancilliary roles (and do so quite happily to this day), but the soldiers soon learned that the GPMG concept has its limits.

The British-produced version of the Belgian FN MAG is known as the L7A1 or L7A2, and is seen here with its butt removed for the sustained fire role and mounted on a buffered tripod. No feed belt is visible as it is fed in from the left-hand side of the gun from a belt box.

The problem for the soldier was that while a GPMG could make a satisfactory heavy machine-gun it was less successful as a light machine-gun or squad weapon. Most GPMGs use belt-fed ammunition, and when a flapping ammunition belt is dragged through ditches and across country it creates problems for the feed, to say nothing of the task faced by the hapless carrier, who has constantly to free the thing from undergrowth and projections. The GPMG also errs on the weighty side for the squad role, and many in-service GPMGs are far heavier and more awkward to handle than they should be for such use. A simple example of this is deployment of the L7A2 (the British army's version of the FN MAG) in the squad role compared with the lighter and handier Bren Gun which it replaced: many soldiers were not happy at that transition, and remain unhappy to this day.

The L7A1 and L7A2 have been adapted for mountings firing out of the sides of Army Air Corps Lynx helicopters for providing fire support during an airborne landing. A special version for carrying in helicopter pods is known as the L20A1. Although effective, these guns are really too light for this role.

Thus there has been a move back towards the specialist LMG, and with the adoption of the new 5.56-mm (0.219-in) cartridge such LMGs can be really light yet capable of producing appreciable amounts of automatic fire. Today the LMG has returned to its original role of producing automatic fire support for the infantry squad. As these modern squads move they can produce firepower out of all proportion to their numbers from their assault rifles and squad support weapon, but it is the latter that produces the volume of accurately-aimed fire that is tactically so useful.

This move back to the LMG has not done away with the role of the HMG. There is still a place on the modern battlefield for the centrally-controlled volume fire of the heavy weapon. This is still important, for most LMGs are capable of accurate fire only to about 600 m (655 yards) at best, and HMGs often have to tackle targets or target areas at ranges well over 1000 m (1,100 yards). The current 5.56-mm rounds quite simply cannot do this, for their propellant loads are tailored to much shorter ranges. It is true that the recent Belgian SS 109 cartridge has more power at longer ranges than the American M193, but it still cannot match the power of the larger 7.62-mm (0.3-in) round in either its NATO form or the far more ancient (but still good) Soviet equivalent.

Thus the GPMG appears to be fading away as a concept, even if many of the GPMG generation live on in a support role. They will be maintained at company or battalion level and distributed as required, while the lighter weapons will be distributed at squad level. Some observers have remarked that many current light machine-guns are little more than machine rifles, i.e. rifles fitted with heavier barrels and a light bipod, and for some of the designs mentioned in this study this is true; the examples of the Soviet RPK and some of the Heckler & Koch rifles are obvious. But ideally a squad weapon has to be more than a machine rifle, especially if the squad is expected to operate in rough or difficult terrain. Under such conditions it is likely that the LMG will be the only fire support the squad can expect, and it thus has to be capable of more than short bursts of fire.

There is one factor that is now often overlooked when dealing with modern infantry tactics. Modern infantry is usually carried into action on some sort of vehicle (usually an armoured personnel carrier). Frequently the squad weapons, including the machine-guns, have to be fired from inside the vehicle, especially in patrolling and policing situations. Thus special consideration has to be given to the types of mounting the machine-gun will use, and thus to the cost of the basic weapon has to be added the expense of special mountings, be they simple pedestal mounts in Jeeps or more complex ball mountings in armoured vehicles.

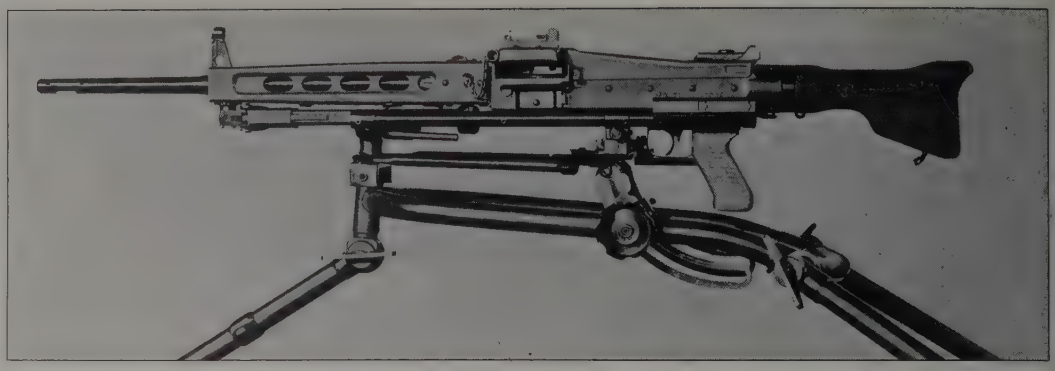
But for many armed forces the image of the machine-gunner is usually that of an overloaded individual lugging about a heavy weapon and festooned with ammunition belts. Not far away is his equally loaded assistant carrying more belts, spare barrels and all his own gear. Contrast this with the future ideal of a heavy support weapon carried on an armoured vehicle, with the squad equivalent carrying a weapon weighing only a little more than the squad's standard rifles. For some armies this is already becoming a reality. The example of the Enfield Weapon System, with the IW and the LSW working closely together and swapping ammunition magazines when required, is to be seen in the British army in the near future. They will not be alone, for the Red Army has been using the AKM/RPK combination for years and the US Army will soon have the M249 Minimi/M16A1 mix. When that happens the M60s, FN MAGs, L7A2s and all the other cumbersome weapons will go back to the heavy support role, and the front-line soldier will be happy at the prospect.

No GPMG can equal the range and stopping power of the heavy-calibre machine-guns. Many countries use the Browning 0.50-calibre in the sustained-fire role. This is the M2 HB version produced by FN, which features a quick barrel change.

Spent cases are seen in flight as they are ejected from the M60's feed mechanism. The M60 uses a mechanism based on the German World War II MG42 allied with some other features derived from the German FG42, also of the war period. The M60 is gas-operated and is the first of its kind to be used by the US armed forces.

SWITZERLAND

7.62-mm SIG 710-3



The Swiss 7.62-mm (0.3-in) **SIG 710-3** is a weapon that on paper appears to be one of the finest of its class. The overall design, construction and reliability of the SIG design is such that it would appear to be a world leader. In fact nothing of the kind has occurred, for this most promising of machine-gun designs has now been taken out of production, and around the world it can be found in service with nations such as Brunei, Bolivia and Chile.

The reason for this strange state of affairs can perhaps be seen in the fact that when the Swiss produce any weapon design they do so in a manner that can only attract superlatives. The Swiss produce weapons with a magnificent degree of care and attention to finish, and while people may be willing to pay heavily for similarly-engineered Swiss watches, they are not willing to pay on the same scale for machine-guns. The SIG products tend to be expensive, and in a world where machine-guns can be produced on simple machine tools and metal stamping jigs the finely machined weapon has little chance of commercial success.

The SIG 710-3 is actually the third in a series of machine-guns, the first of which were produced during the early post-war years. In simple terms the first SIG 710 models were machine-gun versions of the Swiss Sturmgewehr Modell 57 (assault rifle model 1957), and the machine-gun employs the same delayed roller and block locking system as the CETME and the Heckler & Koch rifles. On the Swiss weapons the system constitutes a form of delayed blowback, with the chamber fluted to prevent spent cases 'sticking'. The first SIG 710s were virtually hand-made weapons that attracted much attention (but few orders), so an increasing number of production expedients was incorporated into the design, to the point where the SIG 710-3 makes use of some stampings; needless to say, these are of very high quality. The machine-gun sports some features from German weapons. The Swiss were very influenced by the MG42 and in the years after the war produced several designs based on features of the model. The SIG 710-3 trigger mechanism is the same as that of the MG42, and so is the ammunition feed which is so efficient that it accommodates both American and German belt linkings without trouble.

The locking system is identical with that employed on the Sturmgewehr 45 which failed to reach service with the German army before the surrender of May 1945.

But the SIG 710-3 does have many original Swiss features, not the least of which is the type of rapid barrel change. Many extras were developed for these machine-guns, including one buffered tripod for sustained fire. Special features such as dial sights and telescopic sights were also produced, and in the end the SIG 710-3 could be regarded as one of the most advanced machine-guns available anywhere. But it was all for nothing as far as SIG was concerned, high development and production costs (combined with the strict rules of the Swiss government regarding arms sales) leading to an early exit from production.

The 7.62-mm (0.30-in) SIG 710-3 general-purpose machine-gun was based on German wartime design experience and should have emerged as one of the finest machine-gun designs ever, but in the event only small numbers were produced.

Specification
SIG 710-3
Calibre: 7.62 mm (0.3 in)
Weights: gun 9.25 kg (20.39 lb); heavy barrel 2.5 kg (5.51 lb); light barrel 2.04 kg (4.5 lb)
Lengths: gun 1143 mm (45 in); barrel 559 mm (22 in)
Muzzle velocity: 790 m (2,592 ft) per second
Rate of fire: (cyclic) 800-950 rpm
Type of feed: belt

USA

7.62-mm M60

The **M60** is a general-purpose machine-gun that can trace its origins back to the latter period of World War II, when it was known as the **T44**. The design was greatly influenced by the new German machine-gun designs: the ammunition feed is a direct lift from the MG42, and the piston and bolt assembly was copied from the revolutionary 7.92-mm (0.312-in) Fallschirmjägergewehr 42 (FG42). The T44 and its production version, the M60, made extensive use of steel stampings and plastics, and the first examples were issued for service with the US Army during the late 1950s.

These first examples were not a success. They handled badly and some of the detail design was such that changing a barrel involved taking half the weapon apart. These early difficulties were gradually eliminated, and the M60 is now as efficient a weapon as any, but many serving soldiers still profess not to like the weapon for its generally awkward handling properties. But the M60 is the US Army's first general-purpose machine-gun, and it now serves in a host of roles.

In its basic form as a squad support weapon, the M60 is fitted with a stamped steel bipod mounted just behind the muzzle. For this purpose it is carried by a small handle which is rather flimsy for the loads placed on it; moreover the point of balance of the handle is entirely wrong. Instead many soldiers prefer to use a sling, and the weapon is often fired on the move while being steadied by the sling. For the light machine-gun role the M60 is a bit hefty, but it will be replaced in the near future by the 5.56-mm (0.219-in) M249 Minimi for the US Army. For heavier use the M60 can be mounted on a tripod or on a vehicle pedestal mount.

Some special versions of the M60 have been produced. The **M60C** is a remotely-fired version for external mounting on helicopters. The **M60D** is a pintle-mounted version with no butt for mounting in helicopter gunships and some vehicles. The **M60E2** is a much-altered variant for use as a co-axial gun on armoured vehicles.

Throughout much of its production life the M60 has been manufactured by the Saco Defense Systems Division of the Maremount Corporation, which was always aware of the shortcomings of the M60's design, especially in the light machine-gun role. Accordingly the company has now produced what it calls the **Maremount Lightweight Machine-Gun**, which is the M60 much modified to reduce weight and improve handling. The bipod has been moved back under the receiver and a foregrip has been added. The gas-operated mechanism has been simplified, and there is now provision for a winter trigger. The result is a much lighter and handier weapon than the original, although it can now be used only for the light machine-gun role. The new weapon is currently undergoing evaluation trials by several armies.

The M60 is now in service with several armies other than the US Army. Taiwan not only uses the M60 but produces it as well. South Korea is another Asian operator, while farther south the Australian army also has the M60 in service.

The American M60 is a rather bulky and heavy weapon that is awkward to handle. First produced in the late 1940s, it underwent a protracted development programme before it entered service in the late 1950s, and has been widely used ever since. It is now a reliable and efficient weapon used by several armies.

Specification
M60
Calibre: 7.62 mm (0.3 in)
Weights: gun 10.51 kg (23.17 lb); barrel 3.74 kg (8.245 lb)
Lengths: gun overall 1105 mm (43.5 in); barrel 559 mm (22 in)
Muzzle velocity: 855 m (2,805 ft) per second
Rate of fire: (cyclic) 550 rpm
Type of feed: 50-round belt

'Busting Caps'- The M60 in Vietnam

In the desperate close-range actions against the Viet Cong, the M60 machine-gun teams had to achieve fire superiority over a well-armed and skilful enemy – no easy task with a complicated and sometimes temperamental weapon.

In 1884, the prototype Maxim machine-gun (water-cooled) weighed 27.2 kg (60 lb) and fired an 11.43-mm (0.45-in) bullet at the rate of 600 rounds per minute. In 1984, the M60 machine-gun (air-cooled) weighs 10.4 kg (23 lb) and fires a 7.62-mm (0.3-in) bullet also at the rate of 600 rounds per minute. Add the tripod, and you have a total weight of 23.6 kg (52 lb).

The main difference between the two are, of course, accuracy and reliability; but the tactical use (particularly in the US Army) remains the same: the machine-gun is primarily a static defensive weapon, only offensively used to provide fire-support for advancing infantry. In the case of the M60, this has as much to do with the United States' strategic doctrine as to tactics: the USA is perceived only as fighting a defensive war (as in the instance of NATO forces facing a Warsaw Pact advance), and overall, the USA relies on firepower over flexibility and manoeuvrability.

If nothing else, Vietnam showed that the best defence can often be attack, and that flexibility can be as important as firepower. Nonetheless it is best to forget the idea of the M60 being fired from the hip as film-makers would have it: even though the M60 is exceptionally well balanced, after only four rounds on automatic it will pull high and to the right.

As in all weapon systems, there is a distinct gap between the theory and practice of firing the M60. Instructors may (often do) wax lyrical about Dangerous Space (the distance a round or burst remains at a man's height above the ground); Cones of Fire (shot dispersal around lines of fire); and the Beaten Zone (pattern of descending shots). But the M60 machine-gunner in the US Army (or any machine-gunner, for that matter) is interested in accuracy, reliability, maintenance, how easy it is to fire and how easy it is to carry. For its size, the M60 scores well on all points, as well it might, because it owes much of its design to the famous German World War II machine-gun, the MG42, an updated version of which is still in service with the West German army as the MG3. So, remembering that no comparisons with British Bren, LMG or possibly even the GPMG should be made, we should now take a look at the M60 in action. And where else to look but the M60 in Vietnam.

A rifle company has harboured up for the night. With two M60s per platoon (three or four platoons per company) plus at least a couple more M60s belonging to company HQ, plus the 12.7-mm (0.5-in) machine-guns that have been dismounted from the personnel carriers, plus mortars, plus rockets, you can begin to understand why a modern rifle company is said to have a fire power equal to a World War I infantry brigade. If you are the M60 gunner, you will have made sure that your weapon is firmly positioned; that means either using the tripod or resting the barrel on tree trunks or sandbags. If you are firing through a ground-level embrasure, you may be using the attached bipod; but you would prefer not to, because that means you have to use your left hand to hold the butt into the ground when firing on automatic, and that increases the risk of getting your shoulder into too close contact with the butt end, which could mean at best a very nasty bruising, at worst a dislocated shoulder. More to the point, unless you are a 'natural' machine-gunner, it will play all sorts of hell with your accuracy when you are firing on automatic. And as you do not expect to fire on single shot, you will definitely need to be well planted. You have loaded with ball ammunition, with tracer in reserve. In the daytime you might have both incendiary and spotter ammunition in reserve, but you certainly would not need armour-piercing: if the enemy do have any AFVs, they keep them well hidden.

As an M60 gunner, you have an E4 specialist rating. It is not a command rank, but it does put you firmly in charge of (i.e. responsible for) the gun; you are the head man of the three-man crew the M60 requires. In fact, you are not expecting to be called tonight; there are no heavy enemy troop concentrations in the area, so the most you can expect is a sniper, or a few rounds of mortar fire or possibly an artillery barrage. And there will not be very much that you can do about those, at least in your present position.

As the US Army re-equips with a new Kevlar helmet and new body armour, the 7.62-mm (0.30-in) M60 machine-gun soldiers on until the new M279 Minimi replaces it in the light machine-gun role.

M60s are still encountered in South East Asia; many were handed over to pro-American local forces, while many more were captured by various guerrilla and other forces. This example was photographed in North Vietnam in 1975.

Above: A Vietnam M60 is seen in action with an improvised addition to the ammunition feed to ensure a trouble-free entry of the belt into the weapon. Snagged or twisted belts could often cause jams at the most difficult moments, and it was normal for one man to watch the feed at all times to avoid troubles.

Like soldiers the world over, you have managed to make yourself reasonably comfortable . . . until your sergeant walks over to tell you that your squad is going out on ambush tonight and would you (please) be ready to move out in 20 minutes.

The first thing you do is check your weapon. Never mind that you checked it only that afternoon; if it breaks down in a company strong-point, at least there are a minimum of seven other M60s (not to mention the 12.7-mm/0.5-in M2s) to take up the slack while you site a new weapon. On this ambush there will only be one M60 because at night, in the jungle, two M60s will get in each other's way, probably end up shooting their own troops. Your number two carries the spare parts and cleaning kit, and although everything checks out OK, you decide to change the barrel. It only takes two seconds (you once did it in 1.5 in training) and it is not as if you are being wasteful, because your number two always has at least three spare barrels with him. Twenty minutes later, and you are ready to move out.

Your M60 (or 'pig' as you have come to call it) is slung around your neck and shoulders. Spare

Below: The M60 was known as 'the Pig' to the men who had to lug it through the jungle, but it provided the squad with tremendous firepower. Shooting in combat was dubbed 'busting caps', a derisive reference to playing with cap guns as children.

bands of ammunition also criss-cross your shoulders, and you are carrying a box of ammunition in your left hand. Your number two (a private first class) is carrying a box in each hand, plus one on his shoulders, plus spare parts and the cleaning kit. Your number three (a private) is carrying the tripod (it weighs 3 kg/6.7 lb) and even more ammunition than your number two. Tonight the sergeant has decreed that all other squad members will also carry spare ammunition for the M60 (no wonder they call it a 'pig') and it will be our number three's job to make sure the spare ammunition is centralized and available when you need it.

Moving through the night, the two places you do not walk are point and rear. As far as possible, your squad will provide a shield for you until you are in position; you carry the major firepower, and are thus the most vulnerable to a sniper's bullet. The track your squad is following runs through dense primary jungle. It is supposedly clear of mines and booby traps, because the enemy uses it for a courier and supply route; even so, possibly you reflect that one of the good points about being high on a sniper's target list is that someone else is liable to step on a mine before you do. So long as you keep in single file, that is, and make sure to follow the steps of the man in front ... not always easy to do at night in the jungle.

Your sergeant signals that you have reached the ambush point, and indicates to you where to set up. The team swings into action. Normally, it takes less than one minute to be ready to fire from the moment the tripod hits the ground. But tonight, as you will be firing down the track, towards the approaching enemy (no point in firing from the side of the track because you would be too close to get in a proper burst), your weapon has to be clamped on a fixed line of fire otherwise you might end up spraying your own squad. Now, with your weapon fixed, ammunition stacked around you, your number two beside you, everyone and everything camouflaged up, you sit behind your 'pig' and wait. And wait. And wait. And you are probably still waiting when dawn breaks ... unless, just for once, intelligence was 100 per cent accurate and the enemy did appear.

Right: During the Vietnam War the M60 became a virtual symbol of the American presence in the conflict, as cameramen tended to become attracted by the military and aggressive appearance of the weapon. It was widely used in Vietnam, as its high rate of fire was used as a counter to the elusive guerrilla targets.

'Busting Caps' – The M60 in Vietnam

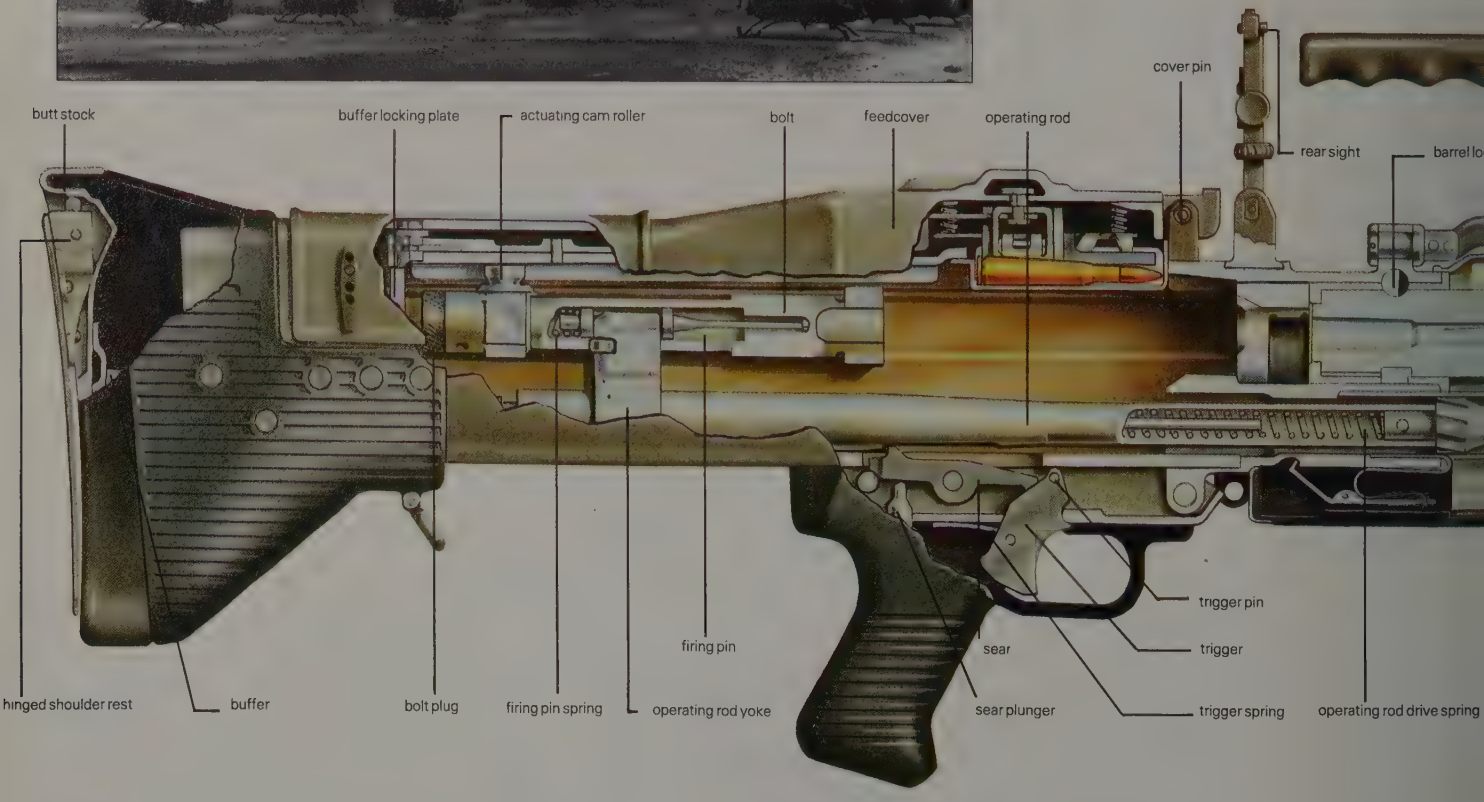
Assuming they did, the firefight would probably have been over very quickly. First, your weapon has an effective range of up to 1000 m (1,100 yards, which means that at 100 m (110 yards) it is one of the most effective weapons available, with a stopping power that is close to being awesome; and second, no one stays around for too long when they are facing the wrong end of an M60. While most armies teach an Immediate Action drill on being ambushed that entails charging through the ambushing enemy, it is a very brave, lucky or foolhardy soldier that manages to charge any machine-gun . . . and lives to tell the tale.

So, if intelligence has been correct, the firefight has probably lasted less than a minute before the enemy have been killed, captured or have simply melted away into the surrounding darkness. And if that has happened, you wonder (not for the first time) why so much spare ammunition is always carried. The answer is simple. Your weapon is the principal, indeed the only, weapon capable of providing fire support for your squad. Your role is not simply to kill the enemy but to save the lives of your fellow soldiers. That means covering fire, when you try to make the enemy keep their heads down and think twice about chasing after you or even firing back. And covering fire expends an enormous amount of ammunition because often you do not have a firm target.

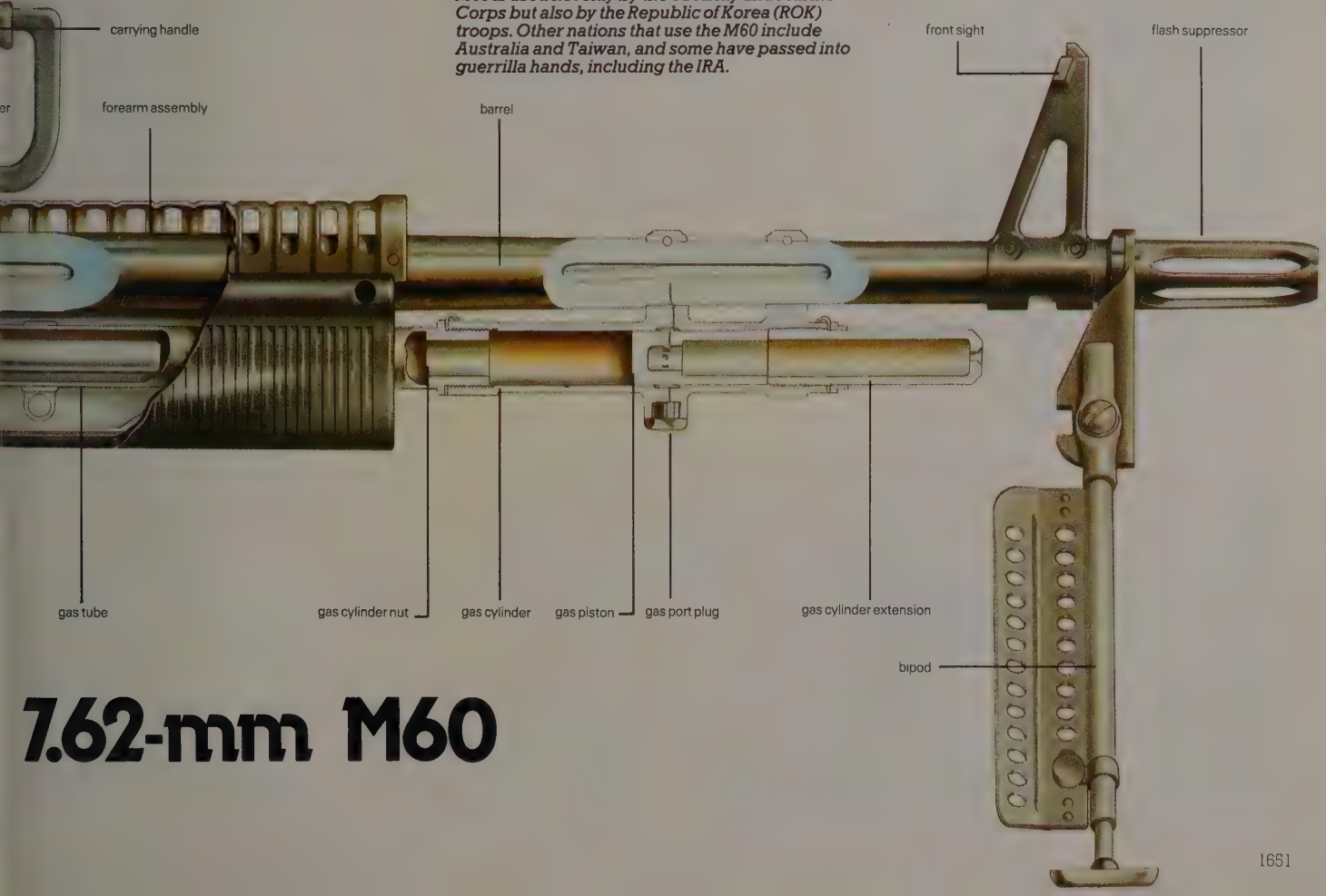
So, whether successful or not, your squad makes its way back to base. This has probably been the last ambush you will go on, because you are due for a transfer to helicopter gunner. Probably 'someone' has noticed how accurate you are, and firing an M60 from a Huey needs accuracy. In fact, when the M60 was first used on 'choppers', it was attached to the skids, which meant it could only fire in the direction the chopper was pointing. But now it is mounted on a pintle by the door that allows you three-way movement; you will soon learn at training school how to use that movement to compensate for the movement of the Huey.

Whatever happens, you seem destined to stay an M60 gunner, unless you are promoted away from it. You might call it a 'pig', but it is more accurate and more comforting than an M16. In fact, it is as accurate as the old M1 rifle; old soldiers in the US army talk about that weapon in the same way as their British counterparts talk about the Lee Enfield.

Left: The machine-guns carried on these Bell UH-1Ds were special versions of the M60, known as the M60D. The M60D was mounted on a pintle and had no butt, and used a special accessory on the feed mechanism. It was widely used in Vietnam for area suppression fire and many M60Ds were mounted on the exterior of vehicles.



Above: An M60 light machine-gun team in action during troop exercises in South Korea, where the M60 is used not only by the US Army and Marine Corps but also by the Republic of Korea (ROK) troops. Other nations that use the M60 include Australia and Taiwan, and some have passed into guerrilla hands, including the IRA.



7.62-mm M60

SINGAPORE

5.56-mm CIS Ultimax 100

The relatively small nation of Singapore has in recent years become a major member of the international defence matériel market. Starting from virtually nothing, Singapore has rapidly built up a defence manufacturing industry and among recent products has been a light machine-gun called the **CIS Ultimax 100** or 3U-100.

The Ultimax 100 can trace its origins back to 1978. To provide a framework in which to work, the newly-formed Chartered Industries of Singapore (CIS) had obtained a licence to produce the 5.56-mm (0.219-in) Armalite AR-18 and also the Colt M16A1 rifles. Using these two weapons as a basis, CIS decided to build in some ideas of their own and the Ultimax 100 was the result. Some of the early prototypes were less than successful, but diligence and the application of some sound engineering removed the early problems, and the Ultimax 100 is now regarded as one of the best weapons in its class.

The Ultimax 100 fires the M193 5.56-mm cartridge, although there is no reason why it could not be converted to fire the new SS 109. It is a light machine-gun that is really light, for CIS was understandably keen to produce a weapon suited to the relatively light-statured personnel found in the Asian world. The result is that the Ultimax 100 handles very like an assault rifle. CIS has taken great pains to reduce recoil forces to a minimum, and has even introduced a feature it calls 'constant recoil'. With this feature the breech block does not use the back-plate of the receiver as a buffer, as is normal in many similar designs: instead a system of springs absorbs the forces and the result is a weapon that can be handled with ease and smoothness. The Ultimax 100 can be fired from the shoulder with no problems at all.

The likeness to an assault rifle is carried over to the ammunition feed. The Ultimax 100 uses a 100-round drum magazine under the body that can be changed with the same facility as a conventional box magazine. The drum magazines can be carried in a special webbing carrier. For firing on the move a forward grip is provided, and to make the weapon even handier the butt may be removed. For more accurate firing a bipod is a fixture and the barrel change is rapid and easy. If required normal M16A1 20- or 30-round box magazines can be used in place of the drum.

The Ultimax 100 Mark 3 light machine-gun is a small and light weapon that is ideally suited for many South East Asian armed forces. It is light and easy to handle and after a period of development is now a reliable and efficient weapon. It is now in full-scale production in Singapore.

Specification
Ultimax 100
Calibre: 5.56 mm (0.219 in)
Weights: gun empty 4.7 kg (10.36 lb); loaded with 100-round drum 6.5 kg (14.33 lb)
Lengths: overall 1030 mm (40.55 in); barrel 508 mm (20 in)
Muzzle velocity: (M193) 990 m (3,248 ft) per second
Rate of fire: (cyclic) 400-600 rpm
Type of feed: 100-round drum, or 20- or 30-round box magazine

Below: The Ultimax 100 uses a drum magazine holding 100 5.56-mm (0.219-in) rounds. It can also use 20- or 30-round box magazines. The full 100-round drum can be fitted in only 11.6 seconds, but more drums can be carried in the special carrier shown here. A bayonet can be fitted and a silencer is available.

Already accessories for the Ultimax 100 abound. Perhaps the most unusual of them is a silencer which is used in conjunction with a special barrel. More orthodox items include a special twin mounting in which two weapons are secured on their sides with the drum magazines pointing outwards. One very unusual extra is a bayonet, a feature which few similar weapons possess. Rifle grenades can be fired from the muzzle without preparation.

To date the Ultimax 100 is available in two versions; the **Ultimax 100 Mk 2** with a fixed barrel and the **Ultimax 100 Mk 3** with the easily-changed barrel. More versions are certain, for the Ultimax 100 has a most promising future. It is already in service with the Singapore armed forces and many more nations are showing a great interest in the weapon. It is certainly one of the handiest and most attractive of the 5.56-mm light machine-guns.

USSR

7.62-mm PK

One very noticeable feature in Soviet small-arms design is the strange mixture of innovation and conservatism that seems to beset every generation of weapons. Despite the impact made by the then-novel 7.62-mm (0.3-in)×39 cartridge used in the AK-47 assault rifle family, Soviet machine-guns have continued to use the much more powerful 7.62-mm×54R cartridge, which retains a distinct rim at its base. This rim was originally used for extraction from the old Mosin-Nagant rifles that can be traced back to 1895, if not before, but the same round is used for the Red Army's current general-purpose machine-gun known as the **PK** series.

There are several members of the PK range. The PK is the basic gun with a heavy barrel marked by flutes along its exterior. This was first seen in 1946, and since then the **IKM** has arrived on the scene; this is an improved version of the PK that is lighter and simpler in construction. The **PKS** is a PK mounted on a tripod which can be used for anti-aircraft as well as ground fire. The **PKT** is a version for use on armoured vehicles, while the **PKM** is a PK mounted on a bipod. When the PKM is mounted on a tripod it becomes the **PKMS**. The **PKB** has the usual butt and trigger mechanism replaced by spade grips and a 'butterfly' trigger arrangement.

The PK appears to be all things to all men, and as far as the Red Army is concerned it is a true multi-role type: the PK is used in roles ranging from infantry squad support to AFV use in special mountings. All the PK machine-guns operate on the same principle, based on the Kalashnikov rotary-bolt system used in many other current Soviet weapons. The interior of the PK is populated by surprisingly few parts: there are just the bolt/breech block, a piston and a few springs. The ammunition feed makes up a few more parts, and that is about it. Thus the PK has few parts to break or jam and it is very reliable. When used in the light machine-gun role the ammunition is normally carried in a metal box slung under the gun. For tripod operation variable lengths of belt are used. In the sustained-fire role the barrel has to be changed at regular intervals even though it is chromium-plated to reduce wear (a common Soviet practice).

These PK weapons must rank among the most numerous of all modern machine-guns. They are used not only throughout the Red Army but also by many members of the Warsaw Pact. The Chinese produce a copy known as the **Type 80**. Both the PK and the Type 80 have been passed on to many nations in the third world and some are now in the hands of 'freedom fighters'.

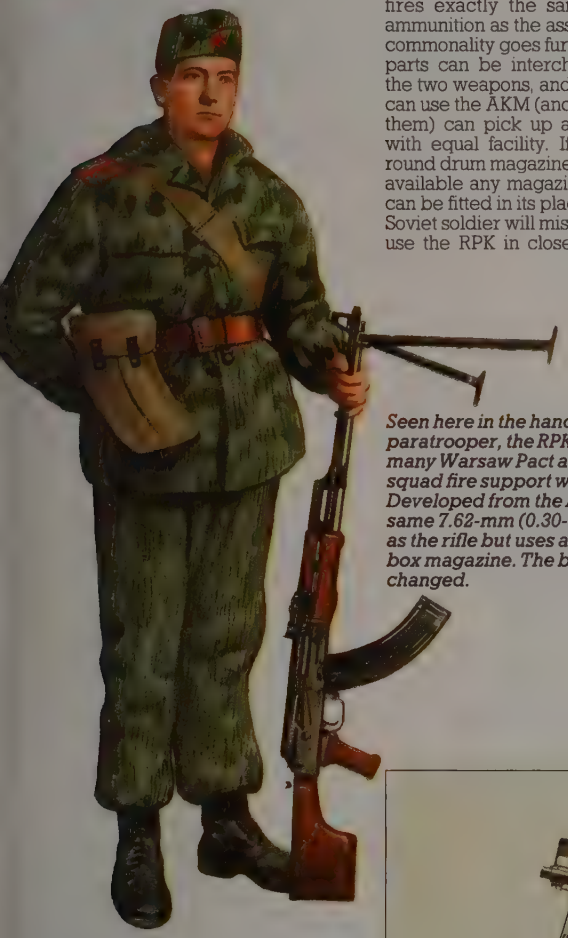
The one odd thing regarding the PK series is the retention of the old rimmed 7.62-mm cartridge. Even the conservative British discarded their beloved 7.7-mm (0.303-in) cartridge decades ago, but the Soviets appear to be more conservative still. Thus there originated the odd alliance of the superb PK machine-gun with all its many fine points and a cartridge that was developed during the 1890s.

Specification
PK
Calibre: 7.62 mm (0.3 in)
Weights: gun empty 9 kg (19.84 lb); tripod 7.5 kg (16.53 lb); 100-round belt 2.44 kg (5.38 lb)
Lengths: gun 1160 mm (45.67 in); barrel 658 mm (25.91 in)
Muzzle velocity: 825 m (2,707 ft) per second
Rate of fire: (cyclic) 690-720 rpm
Type of feed: 100-, 200- and 250-round belts

The Soviet 7.62-mm (0.30-in) PK machine-gun is seen here in its light machine-gun form as the PKM. It is a simple and sturdy weapon with few moving parts, and is widely used by many Warsaw Pact armed forces and other forces around the world.

USSR

7.62-mm RPK



Seen here in the hands of a Bulgarian paratrooper, the RPK is used by many Warsaw Pact armies as a squad fire support weapon. Developed from the AKM, it fires the same 7.62-mm (0.30-in) ammunition as the rifle but uses a larger 40-round box magazine. The barrel cannot be changed.

Whereas the Red Army uses the PK series as a general-purpose machine-gun, the 7.62-mm (0.3-in) **RPK** is very much a light machine-gun used for squad support. The RPK was first noted in 1966 and it may be regarded as an enlarged version of the AKM assault rifle. It has a longer and heavier barrel than the AKM, plus a light bipod, but otherwise the RPK is the same weapon as the AKM.

This commonality of weapons makes a great deal of sense. The AKM fires exactly the same 7.62-mm×39 ammunition as the assault rifle, but the commonality goes further. Some spare parts can be interchanged between the two weapons, and any soldier who can use the AKM (and that means all of them) can pick up and fire the RPK with equal facility. If the special 75-round drum magazine of the RPK is not available any magazine from an AKM can be fitted in its place. One thing the Soviet soldier will miss if he ever has to use the RPK in close action is that it does not have a mounting bracket for a bayonet.

Considering that the weapon is intended as a light machine-gun, it is surprising that the RPK does not have provision for changing the barrel when it gets hot. In order to ensure the barrel does not overheat, recruits are trained to limit burst-firing to about 80 shots per minute. For most tactical purposes this will be more than adequate, but there must be times when this fire rate will have its disadvantages. Apart from the 75-round drum already mentioned, there are curved box magazines holding 30 or 40 rounds. Some RPKs have been seen with infra-red night sights. A copy produced by the Chinese is known as the **Type 74**.

In recent years the Red Army has changed its standard rifle calibre to the new 5.45-mm (0.2146-in)×18 cartridge. For this round the AK-74 rifle was developed, and it follows that a new version of the RPK would follow. It has now appeared as the **RPK-74**. Apart from the scaling down of some parts to suit the smaller calibre, the RPK-74 is in overall terms identical with the RPK.

The RPK appears to be a popular weapon with the Red Army and the many Warsaw Pact nations to which it has been delivered. The type appears to be produced in East Germany and as far as can be determined the RPK is still in production in the Soviet Union (and China). It has been handed out to some nations sympathetic to the Soviet way of thinking, and needless to say the RPK has found its way into the hands of many 'freedom fighters'. RPKs were observed during the recent fighting in Lebanon and more have been seen in action in Angola. Despite its rate-of-fire limitations, the RPK will no doubt be around for many years to come, and the Red Army still retains huge numbers of the type despite the introduction of the RPK-74.

Specification
RPK
Calibre: 7.62 mm (0.3 in)
Weights: gun 5 kg (11.02 lb); 75-round drum 2.1 kg (4.63 lb)
Lengths: gun 1035 mm (40.75 in); barrel 591 mm (23.27 in)
Muzzle velocity: 732 m (2,402 ft) per second
Rate of fire: (cyclic) 660 rpm and (practical) 80 rpm
Type of feed: 75-round drum, or 30- and 40-round box magazines

The Soviet RPK is the standard Warsaw Pact squad fire support weapon. It does not have an interchangeable barrel and so is not capable of sustained fire. The design may be regarded as a development of the AKM assault rifle, and it fires the same 7.62-mm (0.30-in) ammunition. A Chinese version is known as the Type 74.

Automatic Firepower

Machine-guns are at the forefront of all current infantry actions, whether silencing guerrilla ambushes or halting movement in a battle area with sustained fire. In many combat zones, the latest modern weapons serve side by side with guns whose designs pre-date World War II.

When one considers recent conflicts, a factor readily appreciated is that the modern machine-gun has had considerably less effect on the modern battle scene than might have been expected. In the last few years not many wars have settled down to a hefty war of attrition, the main exception being, of course, the prolonged and bitter war between Iran and Iraq. There the old conditions of trench warfare have been re-established and there the machine-gun still retains the malign dominance that it had during World War I. Both sides use a mixture of weapon types. The Iraqis rely mainly on Soviet-supplied machine-guns, while the Iranians also use Soviet weapons leavened by an assortment of types culled from the international weapons market. In this relatively static campaign the conditions are often very like the protracted days of trench warfare in World War I, long periods of inactivity being dramatically interspersed with short periods of horror when the Iranians attempt to use their manpower in human wave attacks. All too often these massed attacks are easily broken up by machine-gun fire before they can even get close to their target trenches.

Happily these scenes are not being repeated anywhere else in the world at the moment. On most flashpoint fronts a more fluid and mobile warfare has been apparent, even when a carefully sheltered enemy is attacked by an equally prepared force. Such conditions occurred on several occasions in the Falkland Islands campaign of 1982. There both sides used the machine-gun to equal effect, but one oddity of that campaign was that both sides were using the same weapon. The Argentines had the Belgian FN MAG, while the British forces used the British-made equivalent, the L7A2. At times during that short conflict there were occasions when the machine-guns pinned down one side or the other: at Goose Green, for example, FN MAGs equipped with night-vision sights pinned down the attackers from the Parachute Regiment for long periods during the nocturnal operation. But for most of the time the machine-guns were used mainly in the light machine-gun role, and at the end of it all heaps of Argentine FN MAGs were captured intact. Unhappily they proved to be of little benefit to the victors. In the transition from Belgian to British manufacturing methods and standards so many changes were introduced into the L7 that few parts of the Belgian and British versions can be interchanged. Thus the war booty was of little use to the British army, though the ammunition was and still is.

Away from the South Atlantic, few people outside the surrounding areas are aware that a nasty little war has been conducted along the borders of South Africa and her neighbouring states. In this theatre the South African defence forces have been conducting a constant counter-terrorist campaign against infiltrating 'freedom fighter' groups, which have constantly made limited and small raids into South African territory.

In such wars the machine-gun is rarely of more than limited value, for ranges are usually short and the terrain often prevents vision in any direction for more than a few yards. The South African defence forces have discovered however, that the machine-gun is a powerful anti-ambush weapon. At any sign of an ambush quick bursts of fire from the ubiquitous FN MAG would soon break up any intended attack. In order to provide themselves with superior mobility the South Africans often moved on trucks or light armoured vehicles such as the Buffel (Buffalo), and the best counter to them was soon discovered by the guerrillas to be the land mine, to which machine-guns do little.

But the guerrillas (and especially the SWAPO guerrillas operating out of Angola) did their best to provide themselves with machine-guns. While their Cuban comrades kept themselves and their Soviet-supplied weapons out of the way as much as possible, the SWAPO guerrillas were left to use whatever they could muster: captured weapon displays show some very odd relics, ranging from MG34 to Czech ZB vz 26 weapons. The fact that so many of these machine-guns have been captured by the South Africans is in itself an indication of how little effect they have had on that conflict. Although sporadic outbreaks still occur, that little war now seems likely to be terminated in the very near future although no doubt the South Africans will remain on their guard for some time to come.

Farther north in Africa, unhappy Eritrea is another location of protracted guerrilla warfare carried out with merciless thoroughness by both sides while around them hordes of people starve to death. This is yet another campaign where the machine-gun can do little more than boost the morale of one side or another. The simple fact is that wherever it is fought, guerrilla warfare rarely has much use for machine-guns, although it is conceivable that the new light machine-guns might find a place for their combination of light weight and firepower. Of course the sudden appearance of a determined man in the middle of a civilian community when he is carrying a machine-gun with every show of using it can have a numbing effect on the onlookers. The mere thought of bursts of machine-gun fire in an enclosed area is usually enough to make anyone obey a terrorist's bidding. But for the guerrilla such opportunities are few and far between, although IRA terrorists have killed British soldiers in Northern Ireland with M60s stolen from arsenals in the USA. Machine-guns are not handy things to carry or to hide, and as the emotional and/or propaganda importance of the machine-gun to an underground organization often appears to be greater than its actual worth, the possession of such a weapon frequently imposes a degree of inflexibility and immobility on the group concerned. This also has happened in Northern Ireland, when IRA terrorists have opted to stand and fight in order to buy time for others to get the precious M60 to a safe house. In some cases this has resulted in the capture of the M60 by the British army and the death or imprisonment of the IRA members concerned.

An L4A4, the 7.62-mm version of the Bren, is seen in a South African position on the border of South West Africa. In the struggle against SWAPO the main aim is to prevent the guerrillas entering the country from their sanctuaries in Angola.

Above: A roof mounting for an MG3 is carried on a Bundeswehr truck. This form of mounting can be used against ground targets, but is primarily intended for use as an anti-aircraft defence mounting. 7.62-mm (0.30-in) machine-guns are really too light for anti-aircraft use, but have an important morale role.

American troops from the US Army's component of the Allied Mobile Force (Land) (AMF(L)) alight from a Bell UH-1 helicopter and immediately take up a defensive position with an M60. The gunner is festooned with a spare ammunition belt, while his Number 2 ensures the belt in use is fed cleanly.

To many observers, the major shooting war in progress today is that being fought daily in Afghanistan, despite the far more massive conflict in progress not far away on the Iran-Iraq borders. Again, this is a war where the machine-gun cannot have much effect on the actual fighting, but where it can have a fearful nuisance effect when handled properly. This is particularly true in the steep mountain valleys where one carefully emplaced machine-gun can hold up a Soviet supply convoy for hours while the hapless Red Army soldiers and Afghan conscripts attempt to find the source of the fire. Fortunately for the Red Army this does not happen often, for the Afghans rely more on their rifles for this sort of ambush. In return the Soviet soldiers can do little more than rake the surrounding hillsides in the hope that some of their rounds find a billet.

The Afghan campaign has seen one return to an old machine-gun tactic, and that is firing upon fixed lines. During World War I machine-guns were often set up to fire on locations where an enemy was likely to be, rather than to undertake aimed fire at a definite target. This ploy was often used at night (when the target was in any case invisible) and at least it had the advantage that it was likely to deny an easy exit or access point to the enemy. In Afghanistan this practice has once more been found useful. The Afghan guerrillas often creep up to an Afghan army or Soviet outpost and open fire with rockets or rifles in order to harass or demoralize rather than destroy anything important. These missions are usually carried out at night, when the defenders cannot readily see the attackers, so here a few pre-laid machine-guns covering likely approach routes or defiles are simply fired off. The machine-guns are emplaced on tripods with their barrels elevated to the correct degree and with their muzzles kept on target by the use of stakes on each side of the barrel. All the firer has to do is pull the trigger and keep the ammunition feed topped up. As the weapon fires the spread of fire is such that there is a good chance of hitting anything in the chosen field of fire.

Left: The uniform of the Bundeswehr Gebirgsjäger and the retention of the MG3 for current use, many years after its World War II predecessor the MG42 first appeared, gives the mountain warfare division of the West German army a definite wartime air; but it is simply a case of using the best uniform and weapon for the job.

In NATO there is at present a state of transition as far as machine-guns are concerned. Many nations, including the USA and the UK, have now chosen to discard the general-purpose machine-gun (GPMG) concept and are reverting to the old ways of using a light machine-gun designed for the job of squad fire support. This will have the advantage of providing the machine-gunner with a far more manageable load and enable the squad to car-

The American M60 machine-gun is used here in the light machine-gun role by a trooper of the 82nd Airborne Division. The ammunition feed belt can be clearly seen, and both in action and on the move it can be something of a nuisance as it tends to snag anything nearby; the belts can cause jams when twisted.

ry just one type of ammunition. At present a squad going into action has to carry ammunition packed into magazines or into belts, which means two logistic loads instead of one. In future the squad fire-support weapon and the standard weapon will use the same box magazines, with all the logistic advantages that this entails. All this is nothing new to the Red Army, which was well to the fore in its post-war tactical analysis and many years ago decided not only to adopt the GPMG concept but also develop a special machine rifle for squad fire support. Thus the Red Army has for long used a mix of APK assault rifles and RPK machine rifles, the latter being used as rather light LMGs. The term light is used advisedly, for the RPK cannot deliver heavy bursts of fire. The Red Army relies upon the PK for this role, which perhaps defeats the object at times, for the PK uses a different ammunition and is also a much heavier weapon. But already the RPK is in the process of being replaced in the Red Army's front-line units by the RPK-74 firing the new 5.45-mm (0.2146-in) round.

An L7A1 is seen on its buffered tripod for the sustained fire role. The tripod uses a spring mounting to absorb the gun's recoil forces to keep the gun on its selected firing line for long periods without having to constantly re-sight the weapon.

The MG3 and its predecessor, the World War II MG42, are widely used outside NATO and some have turned up in guerrilla hands all over the world. The bulk of these are old MG42s from various stocks, but without looking at markings and detail points they are difficult to differentiate from the modern MG3s.

UK

7.62-mm Bren Gun

The latest version of the venerable wartime Bren gun is the British L4A4, chambered for the NATO 7.62-mm (0.30-in) round. It has a new barrel, breech block and a new vertical 30-round box magazine and is now used by support and second-line British Army units.

When considering modern machine-guns, it seems something of a surprise that a weapon as old as the **Bren Gun** should be included, especially as this weapon can be traced back as far as the early 1930s. But the original Bren Guns were chambered for the 7.7-mm (0.303-in) rimmed cartridge, and when the decision was made to convert to the new standard NATO 7.62-mm (0.3-in) cartridge the British armed forces still had large stockpiles of the Bren Gun to hand. It made sound commercial sense to convert them for the new calibre, and such a programme was soon put into effect at the Royal Small Arms Factory at Enfield Lock in Middlesex.

The conversion to the new calibre entailed a complete overhaul, but the task was made easier by the fact that during World War II a Canadian company produced numbers of Bren Guns in 7.92-mm (0.312-in) calibre for China. As this round was rimless, it was found that the breechblocks intended for the 'China contract' were equally suitable for the new 7.62-mm cartridge and these were used in place of the originals. A new barrel was produced with a chromium-plated interior. This not only diminished wear on the barrel but also reduced the need for the frequent barrel-changes required on World War II versions. Thus the new gun was issued with only the one barrel.

The current version of the Bren Gun used by the British Army is the **L4A4**. This is not used as a front-line infantry weapon, but instead is issued to the many other arms of the service who require a machine-gun. Thus the L4A4 is used by the Royal Artillery for anti-aircraft and ground-defence of its batteries, by the Royal Signals for the defence of its installations in the field, by units assigned for home defence, and so on. The L4A4 is also used by the Royal Air Force, and a version known as the **L4A5** is used by the Royal Navy. There is also a version known as the **L4A3** that is not often encountered as it is a conversion of the old Bren Mk 2 gun; the L4A4 is a conversion of the improved Bren Mk 3.

In all these versions the gas-operated mechanism of the original Bren Gun remains unchanged. So few are the changes involved in the change of calibre that the only points of note are that the 7 62-mm version uses a nearly-vertical magazine in place of the old curved equivalent, and the muzzle lacks the pronounced cone-shape of the old weapon.

For the anti-aircraft role the L4A4 has been fitted with some fairly sophisticated sighting arrangements. The L4A4 does not use a tripod as did the old Bren Guns, but instead it can be mounted on the roof hatches of self-propelled guns and howitzers as well as on other armoured vehicles.

So the old Bren Gun soldiers on in a new form, and there seems to be no sign of its passing from use in the foreseeable future. Many of the Commonwealth nations still use the Bren, some in its original 7.7-mm form, so although the original design may be old the weapon is still regarded as effective and in its L4A4 form the old Bren Gun is as good as many far more modern designs.

Specification

L4A4
Calibre: 7.62 mm (0.3 in)
Weights: gun only 9.53 kg (21 lb); barrel 2.72 kg (6 lb)
Lengths: gun 1133 mm (44.6 in); barrel 536 mm (21.1 in)
Muzzle velocity: 823 m (2,700 ft) per second
Rate of fire: (cyclic) 500 rpm
Type of feed: 30-round box

UK

5.56-mm Light Support Weapon (LSW)

With the FN rifle about to be replaced by the 5.56-mm Individual Weapon, the British Army is adopting a squad support weapon of the same calibre to replace the FN MAG general purpose machine-gun. The latter will be retained for the sustained fire role.

Seen here in front of the GPMG is the 4.85-mm version of the Light Support Weapon, produced to complement the proposed 4.85-mm rifle. When NATO adopted the Belgian 5.56-mm round as standard, the 4.85-mm designs were abandoned despite their superior performance.

For many years the standard squad light machine-gun for the British army has been a version of the FN MAG fitted with a bipod and known as the L7A2. While this is a fine weapon, it is rather a cumbersome load and it fires a cartridge that is now generally considered too powerful for the squad-support role. With the imminent arrival of the Enfield Weapon System (or Small Arms 80, otherwise SA 80), the L7A2 is due to be replaced in the squad support role by a new weapon currently known as the **XL73E2 Light Support Weapon** or **LSW**; the L7A2 will be retained for the sustained-fire function for some years to come.

The LSW is one half of the Enfield Weapon System, the other component being the Individual Weapon or IW, which will be the standard rifle while the LSW will become the squad-support weapon. The two new weapons have many things in common and can be easily recognized as coming from the same stable, but the LSW has a heavier barrel and a light bipod mounted well forward under the barrel. There is also a rear grip under what might be regarded as the butt to provide the firer with a better hold for sustained firing.

The term butt is rather misleading as the LSW is based on a 'bullpup' layout in which the trigger group is placed foward of the magazine. This arrangement makes the LSW more compact than a conventional weapon. Much of the LSW is steel, but the foregrip and the pistol grip for the trigger are tough nylonite. The LSW uses the same magazine as the IW, namely a standard M16A1 30-round box.

The LSW has undergone several changes of calibre since it was first mooted. Originally it was calibred for the British experimental 4.85-mm (0.19-in) cartridge, but this was overruled in favour of the American M193 cartridge, which in turn was superseded yet again in favour of the new NATO standard 5.56-mm (0.219-in) SS 109. The first production versions will be for the SS 109 round, and will also have an optical sight known as the Sight Unit Small Arms Trilux or SUSAT mounted on a bracket over the receiver. It will be possible to change this sight for some form of night sight.

The Light Support Weapon shares many components with the 5.56-mm rifle; obvious differences are the heavy barrel, the bipod and the rear grip. The LSW uses the same magazine as the Individual Weapon – the 30-round M16A1 box.

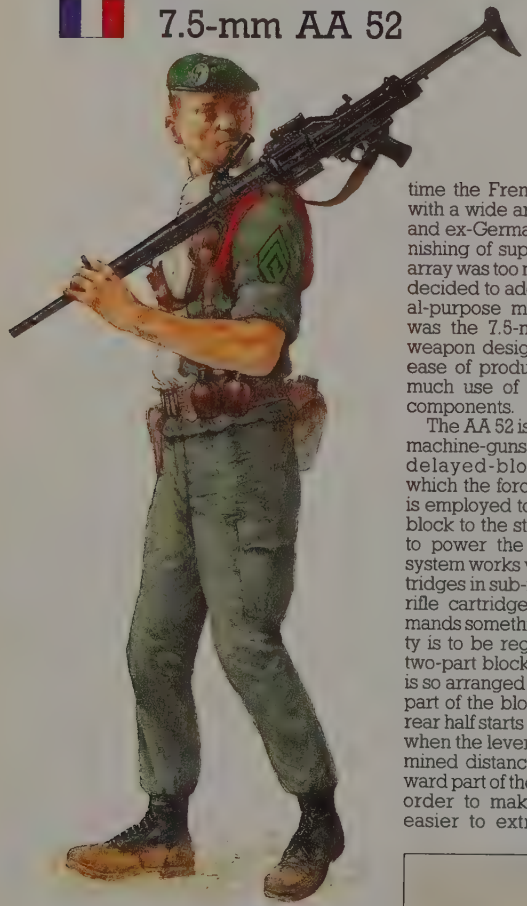
Various accessories will be available for the LSW once it gets into service, which should be some time during 1985 if the current trials go well. A training adapter firing low-powered ammunition will be available, as will a blank-firing attachment. A multi-purpose tool is already in use for stripping and first-line repairs, and it will be possible to fit a sling for carrying. The muzzle attachment is so arranged that it is possible for rifle grenades to be fired from the muzzle, although it is not envisaged that the LSW will be used extensively for this purpose.

The LSW has undergone a protracted development period, some of the period being elongated by the change of NATO standard calibre and other considerations. By the time it reaches the hands of the troops in the near future the LSW should be an excellent weapon with no bugs left to iron out.

Specification
LSW
Calibre: 5.56 mm (0.219 in)
Weights: gun complete and loaded 6.88 kg (15.17 lb); gun less magazine and sight 5.6 kg (12.346 lb)
Lengths: overall 900 mm (35.43 in); barrel 646 mm (25.43 in)
Muzzle velocity: 970 m (3,182 ft) per second
Rate of fire: (cyclic) 700-850 rpm
Type of feed: 30-round box magazine

FRANCE

7.5-mm AA 52



Above: The French Foreign Legion use exactly the same weapons as the rest of the French army and so the AA 52 machine-gun, seen here in its light machine-gun form, is a familiar sight wherever the legion operates.

The machine-gun now known as the **AA 52** was designed and developed directly as a result of the Indo-China campaigns of the early 1950s. At that time the French army was equipped with a wide array of American, British and ex-German weapons, and the furnishing of support and spares for this array was too much for the army, which decided to adopt one standard general-purpose machine-gun. The result was the 7.5-mm (0.295-in) AA 52, a weapon designed from the outset for ease of production, and thus making much use of stampings and welded components.

The AA 52 is unusual among modern machine-guns in relying on a form of delayed-blowback operation, in which the force of the cartridge firing is employed to force back the breech block to the starting position, and also to power the feed mechanism. This system works very well with pistol cartridges in sub-machine guns, but using rifle cartridges in machine-guns demands something more positive if safety is to be regarded. On the AA 52 a two-part block is used: a lever device is so arranged that it holds the forward part of the block in position while the rear half starts to move to the rear; only when the lever has moved a predetermined distance does it allow the forward part of the block to move back. In order to make the spent cartridge easier to extract the chamber has grooves that allow gas to enter between the chamber wall and the fired cartridge to prevent 'sticking', and a cartridge fired from an AA 52 can always be recognized by the fluted grooves around the case neck.

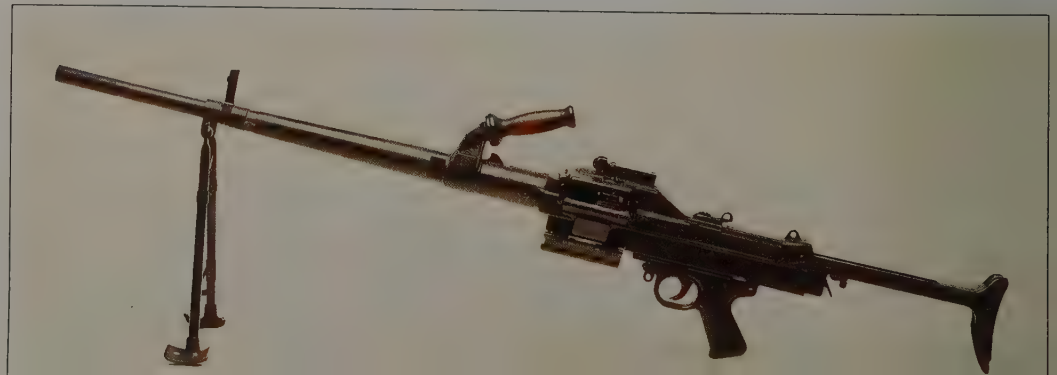
The AA 52 can be fired from a bipod or a tripod, but when a tripod is used for the sustained fire role a heavy barrel is fitted to the weapon. When used in the light machine-gun role the AA 52 is a rather clumsy weapon to carry, especially if a 50-round ammunition box is carried on the left-hand side. For this reason the box is often left off and the ammunition belt allowed to hang free. One unusual feature of the AA 52 is that for the light machine-gun role a monopod is fitted under the butt. This can be awkward at times, and another awkward point is the barrel change: the barrel can be removed readily enough, but the bipod is permanently attached to the barrel and in the light machine-gun role this can make barrel-changing very difficult, especially as the AA 52 barrels have no form of barrel plating that might reduce the temperature of the gun and barrel.

The AA 52 was originally intended to fire a 7.5-mm (0.295-in) cartridge first developed for use by the mle 1929 light machine-gun. This cartridge is powerful enough, but the switch to the NATO 7.62-mm (0.3 in) cartridge left the French army using a non-standard cartridge, and export prospects for the AA 52 were thus reduced. The basic design has therefore been adapted to fire the NATO cartridge in a version known as the **NF-1**. Some of these have been issued to French army units, but exports have not materialized.

Overall the AA 52 is an adequate machine-gun, but it has many features (some of them regarded by some nations as inherently unsafe) that are at best undesirable. The weapon is no longer in production but is still offered for export.

Specification
AA 52
Calibre: 7.5 mm (0.295 in)
Weights: with bipod and light barrel 9.97 kg (21.98 lb); with bipod and heavy barrel 11.37 kg (25.07 lb); tripod 10.6 kg (23.37 lb)
Lengths: with butt extended (light barrel) 1145 mm (45.08 in) or (heavy barrel) 1245 mm (49.02 in); light barrel only 500 mm (19.69 in); heavy barrel only 600 mm (23.62 in)
Muzzle velocity: 840 m (2,756 ft) per second
Rate of fire: (cyclic) 700 rpm
Type of feed: 50-round belt

The French AA 52 uses a delayed blowback mechanism with a fluted chamber to ease extraction. A 7.62-mm (0.30-in) version known as the AA 7.62 NF-1 may also be encountered, but neither model is now in production. Bipod and tripod versions are in use, as are vehicle-mounted models.



WEST GERMANY

Heckler & Koch machine-guns

The West German concern Heckler & Koch, based at Oberndorf-Neckar, is among the most prolific of all modern small-arms designers, and in addition to its successful range of assault rifles and sub-machine guns it also produces a wide variety of machine-guns. It may be an oversimplification, but Heckler & Koch machine-guns are basically modified versions of the company's G-3 and associated assault rifles. They all use the same delay-roller mechanism on their breech blocks, and some of the light machine-guns are simply rifles with heavier barrels and a bipod. To confuse the issue, Heckler & Koch produce virtually every model in belt- and magazine-fed versions, and some are produced in 7.62-mm (0.3-in) NATO or 5.56-mm (0.219-in) calibres, with the added variation in the latter for the new SS 109 cartridge or the older American M193.

One of the 'base' models in the range is the 7.62-mm **HK 21A1**, a development of the earlier **HK 21** which is no longer in production. The HK 21A1 uses a belt feed and may be used as a light machine-gun on a bipod or in the sustained-fire role on a tripod. For the latter, barrel changing is incorporated. Even in this version of the Heckler & Koch range the outline of the G-3 is apparent, and this is carried over to the latest versions of the HK 21, the **HK 21E**, which has a longer sight radius and a three-round burst selection feature. The barrel is longer, and changes have been made to the ammunition feed. There is also a 5.57-mm counterpart to this variant, and this is known as the **HK 23E**.

All the variants mentioned above are belt-fed weapons. There is also a magazine-fed version for every one of them: the **HK 11A1** is the magazine counterpart of the HK 21A1, while the **HK 11E** and **HK 13E** are the magazine counterparts of the HK 21E and HK 23E.

All this may sound rather confusing, but the basic factor that emerges is the ability of Heckler & Koch to produce a machine-gun suited to virtually any requirement. The belt-fed versions may be regarded as general-purpose machine-guns (although the 5.56-mm versions may really be too light for the sustained-fire role), and the magazine-fed versions as true light machine-guns. They offer a surprising amount of interchangeability of spare parts, and the magazines are usually the same as those used on their equivalent assault rifles, making the use of the automatic guns as squad support weapons even easier.

Specification
HK 21A1
Calibre: 7.62 mm (0.3 in)
Weights: gun with bipod 8.3 kg (18.3 lb); barrel 1.7 kg (3.75 lb); 100-round ammunition box 3.6 kg (7.94 lb)
Lengths: overall 1030 m (40.55 in); barrel 450 mm (17.72 in)
Muzzle velocity: 800 m (2,625 ft) per second
Rate of fire: (cyclic) 900 rpm
Type of feed: 100-round belt

The HK 21A1 is a development of the earlier HK 21. It uses a belt feed only, but the belt can be contained in a box slung under the receiver.

The Heckler & Koch HK 11 is the box magazine feed variant of the HK 21 and is a 7.62-mm (0.30-in) weapon.

The Heckler & Koch HK 13 is produced in several versions. This model accommodates a 40-round box magazine.

The Heckler & Koch HK 13E has a three-round burst capability as well as full automatic fire.

The Heckler & Koch HK 21 is no longer produced, but is still in use with nations such as Portugal.

WEST GERMANY

7.62 mm MG3

One of the outstanding machine-gun designs of World War II was the MG42, a weapon that introduced the advantages of mass production to an area of weapon design that had for long clung to traditional methods of construction. With the MG42, the new era of steel pressings, welds and the elimination of many machining processes was allied to an excellent design that attracted widespread respect and attention. Thus, when the Federal Republic of Germany became a member of NATO and was once more allowed a measure of weapon production for rearmament, the MG42 was one of the first designs to be resurrected.

The original MG42 had a calibre of 7.92 mm (0.312 in), but with the adoption of the standard NATO 7.62-mm (0.3-in) round the old design was reworked to accommodate the new calibre. At first stockpiled MG42s were simply modified to this calibre with the designation **MG2**, but in parallel with this activity a production programme was under way by Rheinmetall to produce new weapons in 7.62-mm calibre. There were several variants of this production version, all having the designation **MG1**, although there were some minor changes to suit ammunition feed and so on. The current production version is the **MG3**, still manufactured by Rheinmetall.

In appearance, the war-time MG42 and the MG3 are identical apart from some minor details, few of which can be detected by the untrained eye, and there are more changes between the MG1 and MG3. Overall, however, the modern MG3 retains all the attributes of the original, and many of the mountings used with the MG3 are just adaptations or modifications of the World War II originals. Thus the MG3 can be used on a tripod that is virtually identical to the original, and the twin mounting for anti-aircraft use could still accommodate the MG42 without trouble. There are now available many mountings for the MG3.

The original MG42 was designed for ease of mass production, and this same feature makes the MG3 very suitable for manufacture in some of the less well-equipped arsenals that now abound in 'third-world' nations. The MG3 has proved to be relatively easy for such facilities and it is now licence-produced in nations such as Pakistan, Chile, Spain and Turkey; some of these nations fabricate versions of the MG1 rather than the MG3 proper. Yugoslavia also produces a version of this weapon, but the Yugoslav model is a direct copy of the MG42, still in 7.92-mm calibre and designated **SARAC M1953**.

Within NATO the MG3, or one or other of its variants, are used by the Bundeswehr, by the Italian armed forces, and by nations such as Denmark and Norway. Portugal makes the MG3 for use by the Portuguese armed forces, and is now offering the type for export. Thus from many sources the old MG42 design soldiers on. There is even talk of further development to produce a lighter version, but this is proceeding at a low priority, for the basic design of the MG3 is still as sound as it ever was, and any attempt to improve or modify the original appears to many to be an exercise about as fruitful as redesigning the wheel.

Specification

MG3
Calibre: 7.62 mm (0.3 in)
Weights: basic gun 10.5 kg (23.15 lb); bipod 0.55 kg (1.213 lb); barrel 1.8 kg (3.97 lb)
Lengths: gun with butt 1225 mm (48.23 in); gun less butt 1097 mm (43.19 in); barrel 531 mm (20.91 in)
Muzzle velocity: 820 m (2,690 ft) per second
Rate of fire: (cyclic) 700-1,300 rpm
Type of feed: 50-round belt

The West German MG3 is the modern version of the wartime MG42, and is currently rated as one of the best machine-guns of its type used by NATO. It has a high rate of fire and an easy and rapid barrel change, and can be fired from the bipod shown or from a heavy tripod for the sustained fire support role.

BRAZIL

7.62-mm Uirapuru Mekanika

Over recent decades Brazil has changed from being a defence-equipment importer to a nation that exports over 95 per cent of its defence industry's produce. The nation has undoubted talent for the defence-based industries, and in an effort to harness some of this talent to producing small arms a design team was established in the early 1960s to develop a general-purpose machine-gun. This first design team was led by a team of three experts, but while its initial designs worked they had many inherent problems. These were too numerous for the possibility of acceptance by the Brazilian army, who turned the design problem over to a private concern. This fared no better than the original team, so one of the original triumvirate took over the project on his own.

Using the facilities of a design and research establishment, this individual approach worked. Thus there emerged a design now known as the **Uirapuru Mekanika** after a Brazilian jungle bird. The Uirapuru is a general-purpose machine-gun firing standard NATO 7.62-mm (0.3-in) ammunition. It can be used as a light machine-gun with a butt and bipod, or it can be fired from a heavy tripod for the heavy machine-gun role. It can also be fitted with a solenoid for use as a co-axial weapon on armoured vehicles, and it can be adapted to firing from a number of other mounts.

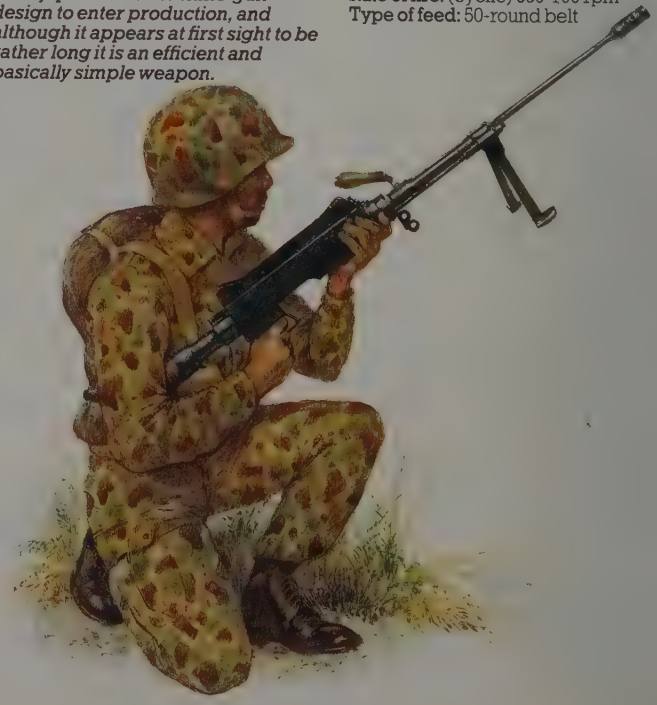
In appearance the Uirapuru is a rather long, ungainly-looking weapon, especially when fitted with a butt for the light machine-gun role. It uses a conventional gas-operated mechanism with an orthodox belt feed for the ammunition, and the barrel can be changed rapidly using a handle that also acts as a carrying handle for the weapon. The receiver of the weapon is very simple, being little more than a length of tube containing the breech block and its return spring. What appears to be a rectangular receiver is in fact the ammunition feed mechanism. The method of tapping off gas from the barrel is also simple. No gas regulating block or valve is used, the gas impingeing directly onto the return mechanism. No provision appears to have been made for firing single shots.

The barrel of the Uirapuru has a large pepperpot-type muzzle brake and it is recommended that the barrel is changed after every 400 rounds have been fired. Most of the parts appear to require some machining, which should ensure a rugged construction. The Brazilian army gave its approval to the Uirapuru after lengthy trials, and the type is now being prepared for full production at a factory near Rio de Janeiro. If past Brazilian salesmanship is any guide, it will not be long before the first examples are seen outside Brazil, for if the Uirapuru can withstand the varied combat conditions that can be encountered in Brazil it will put up with virtually anything, and the simple construction certainly should keep the price of a weapon down.

Specification

Uirapuru Mekanika
Calibre: 7.62 mm (0.3 in)
Weight: with butt and bipod 13 kg (28.66 lb)
Lengths: with butt 1300 mm (51.2 in); barrel 600 mm (23.62 in)
Muzzle velocity: 850 m (2,789 ft) per second
Rate of fire: (cyclic) 650-700 rpm
Type of feed: 50-round belt

The Brazilian 7.62-mm (0.30-in) Uirapuru Mekanika is the first locally-produced machine-gun design to enter production, and although it appears at first sight to be rather long it is an efficient and basically simple weapon.



Iran

Since the fall of the late Shah of Iran in January 1979, Iran has been ruled by a group of Moslem fundamentalists, and in this fact lie the main strengths and weaknesses of the modern Iranian armed forces. The strengths include what is virtually a nation in arms defending its territory and its faith, the latter producing a military fervour that provides a powerful morale and motivating force. The weaknesses come with the same Moslem fundamentalism applied to power politics in which the armed forces have been purged and 'cleansed' of any personnel or influences thought to endanger the status or power of the regime. Thus professional military personnel have been either executed or removed from office, leaving military direction to various forms of revolutionary guards who have repeatedly shown themselves to have more fervour for action than military ability. In foreign affairs the fundamentalist regime has conducted itself in such a way that it has virtually no allies to provide support of any kind, and the internal economics of Iran are now a shambles.

During the Shah's regime the armed forces (particularly the army) were provided with all they desired and more. Vast sums from oil revenues were spent on obtaining the finest equipment on the market and a lavish support infrastructure was established, often employing imported knowhow and personnel. With the fall of the Shah all this changed. The armed forces became the subject of scrutiny and suspicion, and many senior officers were simply killed or allowed to leave the country. Then in September 1980 came the war with Iraq.

At first the Iranian armed forces did well, severely repulsing the invading Iraqis. But the war then degenerated into two opposing defensive lines, and despite a number of offensives and counter-offensives the war has now settled into a conflict of simple attrition and waiting for one side or the other to break. The war has also seen the loss of a great deal of the Iranian armed forces' equipment, either by enemy action or through lack of spares and maintenance. Thus the army is now severely limited in the numbers of weapons it has to hand, and the air force has only a handful of serviceable aircraft left. The navy has all but ceased to exist apart from a few coastal vessels. For this reason it is not possible to publish an 'Order of Battle', for any manpower or weapon totals would be at best simple guesses or pure hypothesis.

The Iranian Army

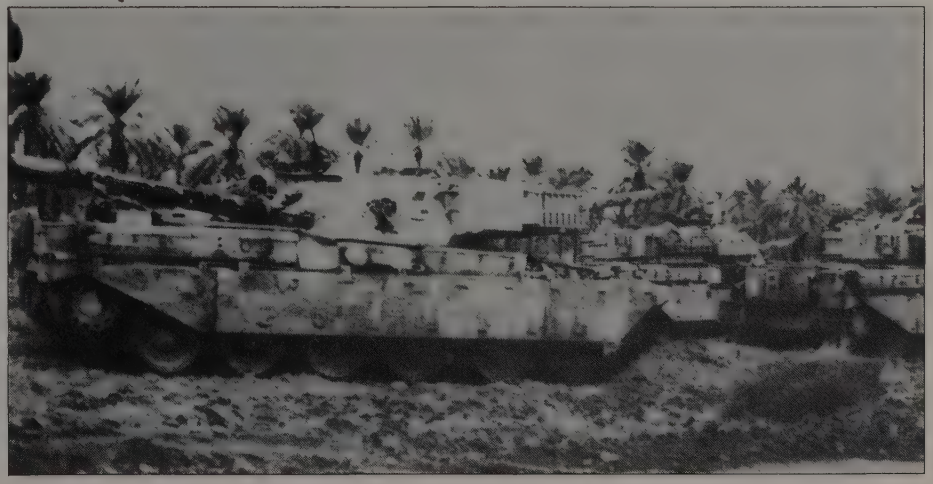
The Iranian army can now be roughly divided into three main components: the old regular army together with its conscript bulk; the Revolutionary Guard Corps or *Pasdaran,* the loose organization that now provides the bulk of Iran's military manpower; the *Bassej,* who may be regarded as little more than barely trained cannon-fodder; and the *Herzbollahi,* who are a form of home defence force of about the same military status as the *Bassej.*

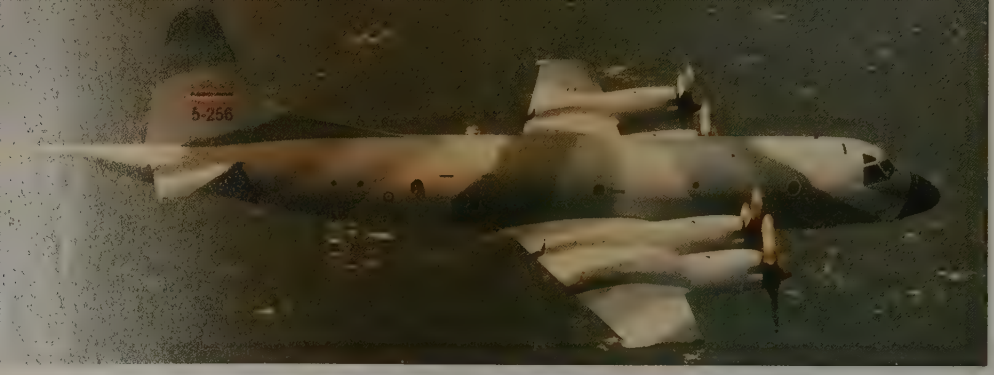
The regular army now exists as a closely defined force of about 50,000 officers and men, whose main role is to train the conscripts who pass through the ranks at the rate of about 100,000 at any one time to complete their 24 months' service (although few complete the full term). At one time the army had three armoured divisions equipped with Soviet T-54/55s and T-62s (about 190) along with a force of 300 Chieftains and 300 M47s or M48s and 150 M60s. Exactly how many of this force are left is now almost impossible to say. Many have been lost to enemy action, and more have been dug into the defensive fixed lines along the border between Iran and Iraq to act as pillboxes. Large numbers must be unserviceable for lack of spares and the required maintenance. The same must be said of most of the army's other equipment, which ranges from Soviet trucks and BMP MICVs to Brazilian EE-9 armoured cars. Much of the artillery, which includes the usual array of Soviet and American towed and self-propelled equipments, appears still to be operational, but ammunition stocks for most of the guns, including the Soviet 122-mm (4.8-in) rocket-launchers, must by now be getting low. For anti-aircraft defences the army has to rely on light towed weapons rather than the more complex US Improved HAWK and Soviet self-propelled ZSU-23-4.

While the army is still retained for its expertise and staff ability, combat is now generally assumed by the *Pasdaran,* or Revolutionary Guard Corps.

Iranian Chieftains captured intact by the Iraqis outside Abadan in 1981. Despite their qualitative superiority, some 200 Chieftains fell into Iraqi hands as the Iranian army, weakened by the loss of professional officers, retreated in confusion. There are reports that some of the captured Chieftains are being overhauled by the Iraqis before delivery to the Royal Jordanian army in return for King Hussein's assistance.

Spearheading both the military effort and the Islamic revolution inside Iran are the Revolutionary Guards. 125,000 strong, their equipment is motley and their training mediocre, but their determination to stamp the Middle East with their brand of extremist religion ensures continuing conflict.





Six Lockheed P-3F Orions were procured before the revolution. It is now believed that only two aircraft are fully operational, with two lost and two cannibalized. Operations are conducted from Bandar Abbas (Tactical Air Base No. 9).

...ed out of the eager revolutionaries who ... about the fall of the Shah, this is now a ...ionary shock force whose men are regarded ... defenders of the Moslem fundamental... ...ment. They number about 150,000, and are ... ...ased with appropriate equipment. What ... weapons they require they take from the ... *Pasdaran* is organized into battalions ... ...n brigade groups, sometimes in co... ...h the army and sometimes independ... ...are supposed to be naval and air ele... ...ments of the *Pasdaran*, but such elements are believed to be nominal only.

The *Bassej* is at least partially trained and equipped ... ...s (the usual Iranian service rifle is the Heckler und Koch G3). Operationally, the young and almost fanatical volunteers are attached to front-line units: they are used mainly as massed infantry in the offensive, and generally advance in the 'human wave' formation that produces massive casualties in their ranks. Of late volunteers for the *Bassej* have started to fall in number, so its ranks have been swelled by hapless members of the *Herzbollahi*. This organization is nominally a home-defence force, but the total of no less than 2,500,000 comprises all available able-bodied men and youths. Many members are volunteers, but many others are detailed by local administrations to meet imposed quota requirements. Training for the bulk of the members is at best sketchy, and few weapons are ... until the men are sent to a front. In many ... fanaticism has made the *Herzbollahi* units into formidable combat forces, but their casualties have been very high.

In addition to the three main formations mentioned above, the army can still call upon a few reserves who have passed through the army conscript or regular training process, though most of these assets have now been impressed into some form of service or another. The army has available the gendarmerie, which includes border guards and the *Mostazafin* (a type of civil guard), but both of these are usually assigned to internal security.

In all its forms the Iranian army is still a formidable fighting force, though it is now being drastically affected by a general lack of equipment, spares and ammunition. As a result of the extreme policies adopted by Iran's Islamic ruling elite there now appears to be little chance that this situation will be remedied in the near future. The only practical ally now possessed by Iran is North Korea, and as North Korean aid has to be airlifted in Boeing 747SP transports, such aid is very limited although reports have been made that some Type 59 tanks have been delivered.

At one time the Army Aviation Command disposed of 65 light aircraft and some 470 helicopters. How many of these are still operational it is impossible to discover. Heaviest of the helicopters were 92 Boeing Vertol CH-47C Chinooks.

The Iranian Air Force

The late Shah lavished as much attention and money on the air force as he did upon the army, but with his fall the air force suffered rather more from the Islamic fundamentalists than did the army. Many of the air force officers were considered as too 'westernized' by the new regime and were treated accordingly. Many were either executed or forced to leave the country; some did so by desertion (a course of action still widespread), taking their aircraft with them: not surprisingly this has had a disastrous effect on the combat efficiency of the air force. Many of the best men have now gone, and this situation is exacerbated by the lack of spare parts and maintenance for the more sophisticated equipment, among which can be found some of the most advanced aviation hardware in existence.

For example, at one time the air force had four squadrons equipped with a total of 77 Grumman F-14A Tomcat fighters. It is now doubtful if more than five could be made operational, and those only by a process of cannibalization of other aircraft. The same could be said of the 90 McDonnell Douglas F-4 Phantoms that once equipped 10 squadrons. Now fewer than 10 are left and these are reserved for the defence of oil installations and the capital, Tehran. It is likely that larger numbers of Northrop F-5E and F-5F fighters are still operational as these are much simpler aircraft to maintain, and one source states that about 50 remain. The same can be said for the fleet of Lockheed C-130 transports, and a number of the original fleet of 52 are still operational. It is unlikely that many of the Rapier and Tigercat surface-to-air missile squadrons are still operational.

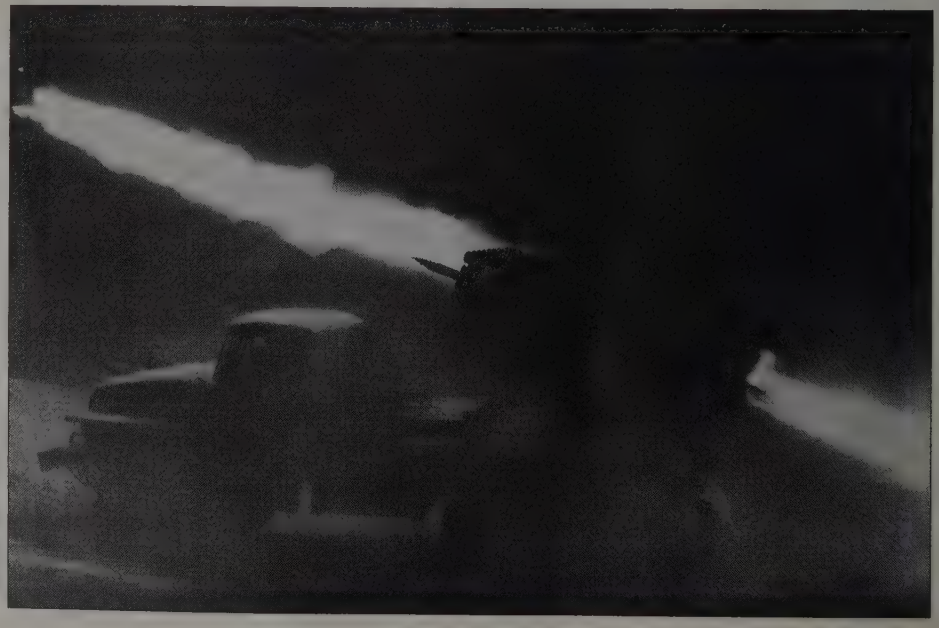
Some of the fleet of 12 Boeing 707 and seven Boeing 747 transport aircraft (some of the Boeing 707s were also used as tankers but this role is unlikely to have been retained) are still operational and maintain a tenuous link with the commercial arms trade abroad, through which some spares for the F-4s and F-5s have been channelled. High prices are known to have been paid for such purchases despite the fact that many of these spares are of doubtful quality. Reports have been made that some new aircraft have been obtained via North Korea, mainly MiG-19s and MiG-21s along with ex-Chinese F-6 fighters, but these reports have yet to be confirmed.

The Iranian Navy

The Iranian navy has never been a large naval force, but the recent war has made it much smaller and current operational missions are confined largely to coastal patrols and the defence of the oil installations at Kharg Island. At one time the main strength of the navy was invested in three destroyers and four frigates (some of them missile-armed), but most of these are now either harbour-bound or have been lost during combat missions against Iraqi naval forces. The rest of the vessels are either ex-American corvettes (of which only two out of four now remain) and a larger number of small patrol vessels. It must be assumed that the fleet of eight SRN-6 and six BH-7 hovercraft is no longer operational.

A small navy air arm is still maintained, and some reports mention that two Lockheed P-3F Orions are still operational. A fleet of 16 helicopters (10 Sikorsky SH-3Ds and six Sikorsky RH-53Ds) may still be operational, but the helicopters are no doubt subject to the same spares restrictions as the equipment of other armed forces. However, the navy is able to obtain some sort of priority due to its importance in guarding the oil installations and shipping lanes on which the shaky Iranian economy still depends. The recent attacks on oil tankers in the Persian Gulf have emphasized the importance of the maritime approaches to Kharg Island, and many of the remaining navy vessels are now stationed near there; other bases are at Bandar Lengeh, Bandar Abbas, Bushehr, Bandar-e-Khomeini and Bandar-e-Anzali.

A Soviet-supplied BM 21 122-mm 'Katyusha' rockets Iraqi positions on the southern front. Since the Iraqi invasion ground to a halt, the war has stagnated into a series of artillery duels punctuated by clumsy Iranian counterattacks. The BM 21 fires a 40-rocket salvo to a maximum range of 20.5 km (12.7 miles).



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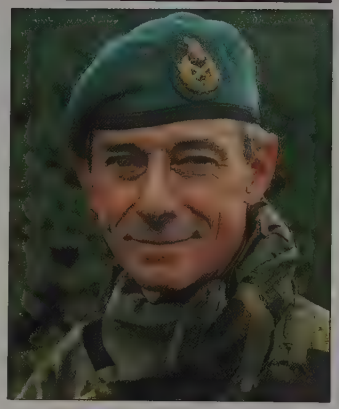

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Modern Maritime Aircraft

The most sophisticated modern maritime patrol aircraft are those which have significant ASW capability, such as the Dassault-Breguet Atlantic. The advanced sensors required to track submarines are matched by the range of armaments carried in capacious weapons bays.

From the oilfields of the North Sea to the myriad islands of the Philippines and Indonesia, the maritime boundaries of the modern world are assuming an ever-increasing economic importance. The vast areas involved must be guarded, and by far the most effective and far-reaching method is from the air.

One of the most often repeated statistics concerning the Earth is that two-thirds of its surface is covered with water. A further fact worthy of mention is that many who live on the land have a keen interest in what happens on and under the water. Other countries' warships, illegal fishermen, smugglers and several sources of pollution are to be found on the high seas, and it is an unwise government that takes an interest only when such problems come within sight of the coast.

Aircraft represent a highly effective method of locating these potential problems in the oceans' vastness, most (but not all) such aircraft being land-based types. The larger amongst these, possessing considerable range, are designated maritime patrol or maritime reconnaissance aircraft, and are exemplified by the US Navy's Lockheed P-3 Orion patroller and the RAF's BAe Nimrod MR.Mk 2 reconnaissance platform. Such aircraft are extensively equipped with complex avionics for the difficult task of locating submarines, and their armament includes depth charges and torpedoes. They may also carry medium-range missiles to provide an anti-surface vessel (ASV) capability.

Of lesser sophistication are the maritime surveillance aircraft, usually equipped with radar, but lacking anti-submarine warfare (ASW) equipment except of the simplest kind. It is these which are most often adaptations of transport aircraft or business jets for protection of economic zones, and in several cases they carry little or no weaponry. However, recent models of the Fokker F.27 Maritime, with their missile armament, have clearly moved into a higher bracket and are to be regarded as front-line equipment.

An almost universal aspect of maritime aircraft is that they are equipped for search-and-rescue (SAR) missions, the usual requirements being carried including emergency kits (containing an inflatable boat, food, etc.) and the appropriate radios for direct contact with other emergency services. It is in this role that MR aircraft often make the news, but to seagoing nations their principal role is as the fast, long-range 'eyes and ears' of the navy.

Operating above two 'Oberon' class submarines of the Royal Navy, the British Aerospace Nimrod has for more than a decade been one of the most advanced maritime reconnaissance aircraft in the world. In addition to its reconnaissance function, the Nimrod also has the comprehensive electronic and weapon fit necessary to hunt submarines.

BRAZIL

EMBRAER EMB-110 and EMB-111

EMBRAER of Sao José dos Campos, Brazil, came into operation only in 1970 but has already built more than 3,000 aircraft and has made Brazil a leading aircraft producer. Its wide range includes the best-selling **EMBRAER EMB-110 Bandeirante** (pioneer), sold in numbers as a light twin-turboprop airliner even to the UK, the USA and France. The **EMB-110S1** is a remote-sensor geophysical model with MAD tailboom, the **EMB-110P1K** is a mass-produced military transport (called **C-95A** by the Brazilian air force) and among many other offshoots is the short-body pressurized **EMB-121 Xingu** family called **VU-9** by the Brazilian air force and bought as the standard aircrew trainer and liaison transport for the French Armée de l'Air (25) and Aéronavale (16). The **EMB-111** is a comprehensively equipped maritime surveillance aircraft, with a mainly Collins avionics fit but including AIL nose radar, Bendix autopilot, Thomson-CSF passive ECM and optional Omega receiver. The normal crew numbers 3-7 and the interior is equipped not only with displays and observation stations but also for cargo and paratrooping or equipment dropping. The **EMB-111** first flew on 15 August 1977, and 12 were sold to the Brazilian air force coastal command with designation **P-95**. The first of a growing list of export customers was Chile, whose aircraft have full de-icing and passive ECM under the nose.

Specification

EMB-111

Type: maritime surveillance aircraft

Powerplant: two 559.3-kW (750-shp) Pratt & Whitney of Canada PT6A-34 turboprops

Performance: (at maximum weight, ISA+15°C, a severe criterion) maximum cruising speed 385 km/h (239 mph); range at 3048 m (10,000 ft) with 45-minute reserves 2945 km (1,830 miles)

Weights: empty 3760 kg (8,289 lb); maximum take-off 7000 kg (15,432 lb)

Dimensions: span 15.95 m (52 ft 4 in); length 14.91 m (48 ft 11 in); height 4.91 m (16 ft 1.3 m); wing area 29.1 m² (313.24 sq ft)

Armament: four wing pylons for four pairs of 12.7-cm (5-in) HVAR rockets or launchers each with seven 69.9-mm (2.75-in) FFAR rockets, or three stores pylons plus 50 million candlepower searchlight; other gear includes smoke bombs, markers, flares, chaff dispenser and loud hailer

Entering service with the Forca Aérea Brasileira in April 1978, the EMB-111 carries pairs of 12.7-cm (5-in) HVAR rockets together with a searchlight of 50 million candlepower on the starboard wing.

USA

Grumman HU-16 Albatross

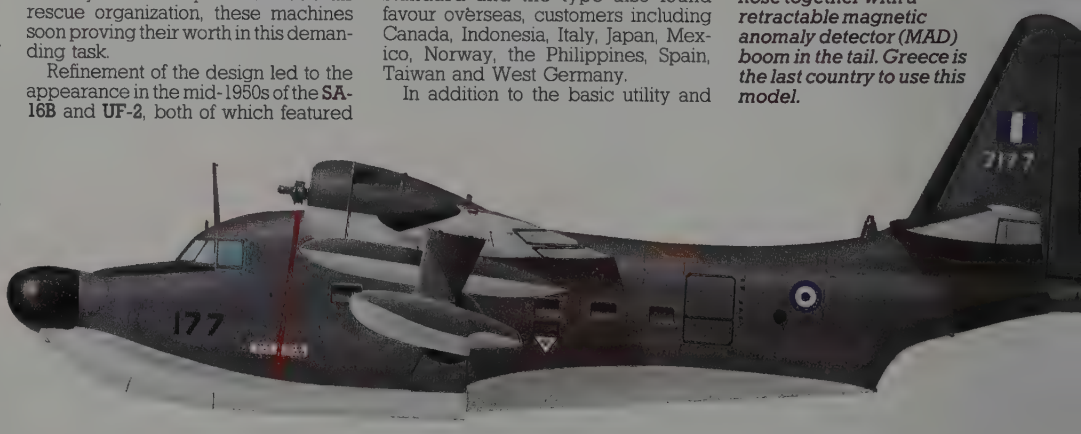
Although no longer operational with any element of the US armed forces, the distinctive **Grumman Albatross** amphibian still serves with a number of other air arms in a variety of roles ranging from air-sea rescue through liaison and communications to anti-submarine warfare. It also holds the distinction of being the last amphibian to see service with the US armed forces and in its heyday established a number of world records for aircraft in its class.

A logical outgrowth of earlier Grumman amphibians such as the Goose and Widgeon, the Albatross began development in the closing stages of World War II, the aircraft which eventually emerged being significantly larger than its predecessors although it bore a strong family resemblance. Initially ordered by the US Navy, the prototype **XRJ2F-1** made its maiden flight on 24 October 1947, subsequently entering service as the **UF-1** in July 1949. Originally intended to fulfil mainly utility functions, the Albatross soon proved to be a most versatile machine, and another notable early customer was the US Air Force which acquired a large number of **SA-16A** aircraft for the Military Air Transport Service's air rescue organization, these machines soon proving their worth in this demanding task.

Refinement of the design led to the appearance in the mid-1950s of the **SA-16B** and **UF-2**, both of which featured increased wing span and larger tail surfaces as well as more effective de-icing equipment. Many earlier aircraft were eventually brought to this later standard and the type also found favour overseas, customers including Canada, Indonesia, Italy, Japan, Mexico, Norway, the Philippines, Spain, Taiwan and West Germany.

In addition to the basic utility and

The ASW version of the Grumman HU-16 is distinguishable by the larger search radar in the nose together with a retractable magnetic anomaly detector (MAD) boom in the tail. Greece is the last country to use this model.



rescue versions, an ASW-capable Albatross was also conceived by Grumman, this featuring such familiar items as nose-mounted radar, a searchlight, a MAD (Magnetic Anomaly Detector) boom and specialized ordnance including torpedoes and depth charges. Most, if not all, ASW-configured aircraft were simply conversions of HU-16Bs, and they retained the same designation following conversion, examples of the type being known to have served with the air arms of Greece, Spain and Turkey, although only the first is believed still to use the Albatross for ASW duties.

Specification
HU-16B Albatross
Type: anti-submarine warfare, utility and rescue amphibian
Powerplant: two 1062.6-kW (1,425-hp) Wright R-1820-76A/76B Cyclone radial piston engines
Performance: maximum speed 380 km/h (236 mph) at sea level; cruising speed 241 km/h (150 mph); range with 4826 litres (1,275 US gal) of fuel 4345 km (2,700 miles); maximum endurance 22 hours 54 minutes
Dimensions: span 29.46 m (96 ft 8 in); length 18.67 m (61 ft 3 in); height 7.87 m (25 ft 10 in); wing area 96.15 m^2 (1,035 sq ft)
Armament: four underwing hardpoints capable of carrying depth bombs, mines, unguided air-to-surface rockets and torpedoes; in addition, depth charges and sonobuoys are carried internally

NETHERLANDS

Fokker F.27 Maritime

The **Fokker F.27 Maritime** is an adaptation of the Friendship turboprop transport, which first flew in 1955 and remains in production to this day. Foreseeing a market for a medium-range maritime patrol aircraft to replace such stalwarts as the Lockheed Neptune and the Grumman Tracker and Albatross, Fokker began conversion of a prototype **F.27MPA** (Maritime Patrol Aircraft) in 1975, this making its initial flight during February 1976. Unarmed in its initial form, the aircraft is suitable for sealane and fishery patrol, offshore oilfield policing, SAR and pollution control, its prime sensor being a Litton AN/APS-504(V)2 360° radar scanner mounted in a ventral radome. Up to six crew members are carried. Peru's navy received the first two F.27 Maritimes in September 1977 and February 1978, whilst other customers have comprised the Spanish air force, with three supplied in 1979 for patrol and SAR missions from the Canary Islands (Spanish military designation **D.2**); the Philippine navy which received three in 1981-2; the Angolan air force with one; the Dutch air force (mixed air force and navy crews) with two delivered in 1981-2 for missions in the Antilles; and the Nigerian air force with two supplied in 1984.

A major upgrading of the design came in 1984 when the **Maritime Enforcer** was revealed, three examples for Thailand's navy being the first order. The Enforcer is an ASW aircraft equipped with Marconi central tactical and sonobuoy processing systems, plus an Alkan stores-management system. It can locate submarines and all classes of surface vessels using not only search radar, but also passive and active acoustic equipment (via sonobuoys launched from bays in the rear fuselage) and an electronic surveillance and monitoring system. Inputs from these sensors, together with visual observations, are fed into a central display controlled by the tactical co-ordinator. Most importantly, however, the Maritime Enforcer has provision for armament; up to six torpedoes, or depth charges for ASW, or up to four anti-ship missiles on a new stores position at the lower sides of the centre fuselage.

The three Spanish F.27 Maritimes operate out of the Canaries on general unarmed patrol and SAR missions. An armed, ASW-dedicated version is available, the Maritime Enforcer.

Specification
F.27 Maritime Enforcer
Type: maritime patrol aircraft
Powerplant: two 1,730-kW (2,320-shp) Rolls-Royce Dart Mk 536-7R turboprops
Performance: cruising speed 463 km/h (288 mph); patrol speed 277-333 km/h (172-207 mph) at 457 m (1,500 ft); initial climb rate 442 m (1,450 ft) per minute; service ceiling 8990 m (29,495 ft); range 5000 km (3,107 miles) with wing pylon tanks
Weights: empty 12519 kg (27,600 lb); maximum take-off 20412 kg (45,000 lb)
Dimensions: span 29.00 m (95 ft 1.7 in); length 23.56 m (77 ft 3.6 in); height 8.50 m (27 ft 10.6 in); wing area 70.00 m^2 (753.5 sq ft)
Armament: up to four Aérospatiale AM.39 Excocet or McDonnell Douglas AGM-84A Harpoon ASMs, or six bombs/depth charges/torpedoes

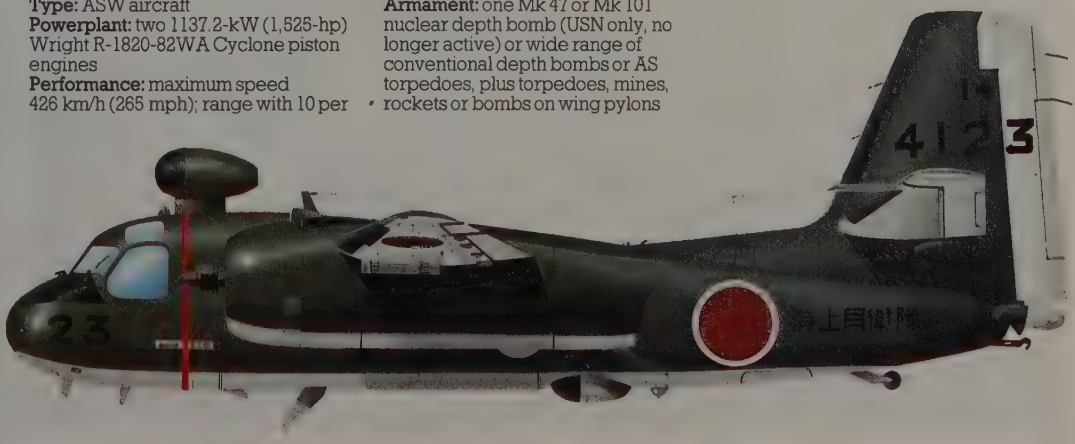
USA

Grumman S-2 Tracker

Still in widespread service over 30 years after first flight (on 4 December 1952), the **Grumman G-89 Tracker** was the first successful carrier-based ASW aircraft, containing the search and attack capability in one aircraft. Piston engines were chosen for sea-level endurance of 9 hours, and the crew of four were seated in a single nose compartment. Weapons were housed internally and under the high-mounted folding wing, and after entering US Navy service in 1954 with the basic designation **S-2** production reached a total of 1,181 in five major versions, not including the **C-1 Trader** COD (Carrier On-board Delivery) transport and **E-1 Tracer** surveillance versions. DH Canada built 100 in two versions, and though many **S-2A** aircraft and other variants were progressively updated, the chief type today is the **S-2E** (245 built) with the longer span, bigger cockpit and bigger tail of the **S-2D** plus a range of improved sensors. The last recipient was the Royal Australian Navy, which lost all but three of its S-2Es in a hangar fire in December 1976; the USN quickly provided 16 replacement aircraft. Several countries use the **TS-2** (usually **TS-2A** conversion) as a trainer; others use **US-2** utility and **RS-2** photographic aircraft.

Specfication
S-2E Tracker
Type: ASW aircraft
Powerplant: two 1137.2-kW (1,525-hp) Wright R-1820-82WA Cyclone piston engines
Performance: maximum speed 426 km/h (265 mph); range with 10 per cent reserve 2092 km (1,300 miles)
Weights: empty 8505 kg (18,750 lb); maximum take-off 13222 kg (29,150 lb)
Dimensions: span 22.12 m (72 ft 7 in); length 13.26 m (43 ft 6 in); height 5.05 m (16 ft 7 in); wing area 46.08 m^2 (496 sq ft)
Armament: one Mk 47 or Mk 101 nuclear depth bomb (USN only, no longer active) or wide range of conventional depth bombs or AS torpedoes, plus torpedoes, mines, rockets or bombs on wing pylons

Primarily a carrierbased ASW aircraft, the Grumman S-2 Tracker no longer serves aboard the carriers of the US Navy, but is still in widespread use worldwide. Japan used the aircraft for many years.



Maritime Conversions of Civil Aircraft

Maritime aircraft are used for a wide variety of purposes, not all of which require the high technology avionics, detection gear and weaponry appropriate to hunting nuclear submarines. For many nations, the maritime role consists of such jobs as fishery protection, prevention of smuggling or search and rescue. Obviously, an advanced ASW-dedicated aircraft is not what is required.

Despite the complex and expensive detection equipment fitted to the major types of maritime patrol aircraft, it may be argued that any aeroplane from which it is possible to see the Earth's surface while in flight can be used for over-water surveillance. Indeed, landlocked Paraguay employs a handful of single-engine Cessnas for river patrol, and the RAF's BAe (English Electric/BAC) Canberras are assigned to visual maritime reconnaissance in an emergency, but these can hardly be described as dedicated MR aircraft. However, to meet the requirements of those countries for which a Lockheed Orion or even a Fokker F.27MP would be inappropriate or too costly, the world's aircraft manufacturers offer a range of adaptations of existing models.

Almost all are twin-engine transports or executive aircraft which are required to patrol only as far as the edge of a country's 322-km (200-mile) exclusive economic zone (EEZ). The minimum standard of modification may be taken as addition of surveillance radar, so that vessels may be sought out rather than happened upon. Invariably there are other low-cost changes such as bulged windows for direct downward view by lookouts, and perhaps a more comprehensive navigation fit. The latter is important if the aircraft's duties are to include identification of vessels fishing illegally on the borders of the EEZ. There may also be a requirement for search-and-rescue operations, for which additional radio equipment is demanded, and the ability to drop liferafts and survival kits is a useful asset.

Such features, plus optional FLIR (Forward-Looking Infra-Red) and LLLTV (Low-Light-Level TV), are offered by Beech in its Maritime Patrol 200T version of the popular Super King Air turboprop twin. Announced in 1977, this has provision for removable wingtip tanks to give a maximum on-station time of nine hours, and customers include the Uruguayan navy, which received one such aircraft in January 1981. A further 15 civilian models have been delivered to the Japanese Coast Guard (known as the Maritime Safety Agency) and two more to Algeria.

Also from the USA is a rather unlikely medium-sized pure jet patroller in the form of the Boeing 737 Surveiller. While retaining the ability to carry 102 passengers, the three Model 737-200s delivered to the Indonesian air force in 1983 have a maritime radar reconnaissance capability provided by a Motorola SLAMMR (Side-Looking Airborne Multi-Mission Radar) whose two 4.9-m (16-ft) blade aerials are mounted on the sides of the upper rear fuselage. Flying at 9145 m (30,000 ft), the aircraft can locate a small ship in heavy seas at a distance of 161 km (100 miles), so that it is able to cover an entire EEZ with a single pass 161 km (100 miles) from the coastline.

Spain's CASA has had some success with its C-212 Aviocar in ASW and patrol/SAR versions, each fitted with a prominent nose radome and (for ASW) such extras as a sonobuoy processing system and electronic support measures (ESM). The home air force has received seven SAR examples, plus two conversions of earlier C-212s, and the ministry of finance has bought another three. Exports have involved a patrol model to Uruguay's air force, fitted with an AN/APS-128 270° search radar, and three similar aircraft to the Venezuelan navy in 1982.

Canadian aircraft

Canada has a very extensive coastline, and relies on Orions and Trackers to meet military MR requirements, but de Havilland Canada has two versions of its well-known STOL family on the international market. The Twin Otter in its DHC-6-300M military guise has a maritime reconnaissance variant with a distinctive chin radome for a Litton AN/APS-504(V)2 radar. Also able to carry light armament on wing pylons, one of this type has been delivered to the Senegalese air force. The Canadian Environment Ministry has acquired a single extended-range DHC-7R Ranger equipped with SLAR and a laser profilometer to provide an image of its targets, though these are no more warlike than icebergs which may threaten shipping lanes and offshore oilfields. In passing, it may be mentioned that coastal patrol and SAR are included in the tasks of the 14 remaining (from 19 delivered) Canadair CL-215 'water-bombers' supplied to Spain's air force.

One of the more successful adaptations for MR comes from France in the form of the Dassault-Breguet Guardian/Gardien versions of the best-selling Falcon 20/200 executive twin-jet. No less than 41 were ordered in 1977 when the US Coast Guard selected the maritime Falcon 20G to meet its medium-range surveillance requirement. Designated HU-25A Guardians, these were delivered from 1982 onwards, fitted with a comprehensive sensor suite including SLAR, FLIR, infra-red and ultra-violet scanners and laser-illuminated TV camera for all-weather detection. Similar, but with less equipment, are the five Gardiens delivered to the French navy for surveillance tasks in the Pacific territories and declared operational in August 1984.

Above: The Australian Government Aircraft Factory Nomad is typical of the many basic aircraft adapted to the maritime function. The Searchmaster B of the Indonesian Naval Air Arm provides a basic MR capability, with a Bendix RDR 1400 forward-looking surface search radar in the extended nose.

Left: Dassault-Breguet achieved a real coup with their sale of the surveillance version of the Falcon 20 executive jet to the US Coast Guard. Known as the HU-25A in US service, the Guardian, as it is called, is not armed, but has a state-of-the-art sensor fit, including radar, ultra-violet and infra-red detectors.

Remaining with European manufacturers, the Dornier range of twin turboprop transports has its MR derivatives fitted with MEL Marec radar in the chin position, including two Do 128-2s with the Moroccan air force and three Do 128-2s operated by the Cameroun air force. Two models of the Do 228 Maritime Patrol are being offered: Version 'A' with Marec II for fishery protection and anti-smuggling; and Version 'B' carrying SLAR as a pollution control aircraft with additional surveillance and fishery roles. Indian production of the Do 228 will include 36 of the 'A' model for its coast guard.

When Denmark chose a surveillance aircraft to protect its interests in the cold waters around Greenland and the Faroes it looked to the United States. From January 1982 onwards three Gulfstream Aerospace Gulfstream IIIs were supplied, their equipment including an AN/APS-127 search radar in place of the normal nose-mounted weather radar and provision for firing of flares and dropping SAR equipment. They have masses of special electronics.

Australia's contribution to the field, the GAF Nomad, is available in Searchmaster B form with Bendix RDR 1400 radar or as the more extensively-equipped Searchmaster L mounting a Litton APS-504(V)2 radar in the chin position. Indonesia's navy has 12 Searchmaster Bs and six Searchmaster Ls; Papua New Guinea operates three Searchmaster Bs; and the Thai navy took delivery of four Searchmaster Ls (equipped with SSQ-801 Barra sonobuoys) in 1984, plus a fifth funded by the United Nations for anti-pirate patrols.

The same APS-504(V)2 radar is fitted beneath the Israel Aircraft Industries 1124N Sea Scan version of the Westwind business twinjet. Three are used by the local air arm for coast patrol (with particular attention paid to possible terrorist infiltration) and a more elaborate ASW version is in prospect. Israeli knowhow is also believed to be employed in the four Lockheed Electra ex-airliners bought for conversion to MR and electronic intelligence (Elint) models by the Argentine navy following the Falklands war.

Facing an embargo on military equipment, South Africa is having difficulty in finding a substitute for its Avro Shackletons (withdrawn in 1984), but short-range patrol work is undertaken by 19 radar-equipped Piaggio P.166S Albatross twins. A maritime version of the current model, designated P.166-DL3-MAR and fitted with four underwing pylons, is on the market, and six are expected to be delivered to Italy's Servizio Nazionale della Protezione Civile for pollution patrols and similar work.

Limited success has been obtained by Piper with its quick-change Maritime Surveillance Cheyenne II, two of which were delivered to the Mauritanian air force in 1981, each complete with a pair of 70-mm reconnaissance cameras, plus a search radar in a pod beneath the port wing. In contrast, however, customers are still awaited for the Transall C.160S (Thomson-CSF VARAN radar) and BAe's Jetstream 31EZ, which will have a belly-mounted radar and be similar in appearance to the four Jetstream T.Mk 3 trainers (Racal ASR 360 radar) ordered by the Royal Navy in 1984.

Above: The Boeing 737-200 Surveillers delivered to the Indonesian air force have a dual purpose; while retaining seating for 14 first-class and 88 other passengers, they are also fitted with high resolution Side-Looking Airborne Multi-Mission Radar, capable of scanning 160 km (100 miles) each side.

Below: Designed as a water bomber to fight forest fires, the Canadair CL-215 is also used for search and rescue, utility transport and coastal patrol. The two aircraft operated by the Royal Thai navy are equipped for coastal patrol, and are fitted with a search radar.

USA

Lockheed P-2 Neptune

In terms of numbers built arguably the most successful post-war maritime aircraft, the **Lockheed Neptune** can in fact be traced as a development back to September 1941, when work began on the company's **Model 26**. However, the more urgent considerations of World War II dictated a very leisurely rate of progress, and it was not until April 1944 that Lockheed received a contract covering the construction of a pair of **XP2V-1** prototypes and an initial production batch of just 15 **P2V-1** aircraft. Subsequent developments of the Neptune enabled the type to remain in continuous production for close to 35 years, thus establishing an exceptional longevity record.

Flown for the first time in prototype form on 17 May 1945, the Neptune duly entered service with the US Navy in March 1947, shortly after the **P2V-2** variant made its maiden flight. Some 81 examples of this sub-type were completed, these being followed by 53 **P2V-3** and 30 **P2V-3W** aircraft, the latter model introducing the ventral radome which was to become such a characteristic feature of the Neptune. Production then switched to the **P2V-4** (later designated **P-2D**), but only 52 were completed before the **P2V-5** (later **P-2E**) made its debut, this eventually becoming the most numerous version, some 424 being produced for service with the US Navy and a number of other countries including Argentina, Australia, Brazil, the Netherlands, Portugal and the UK.

Further refinements to the basic design led to the appearance of the **P2V-6** (later **P-2F**) in late 1952, 67 standard aircraft being followed by 16 specially-configured **P2V-6M** aircraft which were compatible with the Fairchild AUM-N-2 Petrel air-to-surface missile. Lockheed production of the Neptune terminated with the **P2V-7** (later **P-2H**) version, which was the only model to feature auxiliary jet engines from the outset although this feature was later retrofitted to the earlier P2V-5 and P2V-6. The **P2V-7S** (later **SP-2H**) was a conversion with Julie and Jezebel submarine detection equipment. A total of 311 P2V-7s was completed by the parent company, these being supplemented by 48 Japanese-built examples, and it was Japan which was the source of the final production version, namely the **P2V-7KAI** which benefitted from the adoption of turboprop engines, a pair of General Electric-IHI T64s replacing the Wright R-3350 radial engines of earlier Neptunes. Production of the P2V-7KAI (later **P-2J**) eventually ceased with the completion of the 82nd example, this bringing the total number of Neptunes built to 1,133.

Specification

SP-2H Neptune

Type: maritime patrol and anti-submarine warfare aircraft

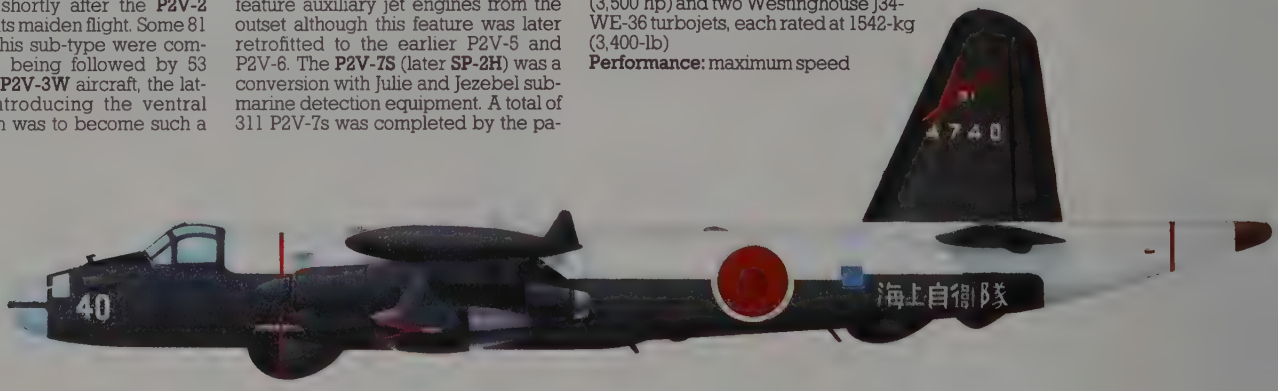
Powerplant: two Wright R-3350-32W Turbo-Compound 18-cylinder radial piston engines, each rated at 2610 kW (3,500 hp) and two Westinghouse J34-WE-36 turbojets, each rated at 1542-kg (3,400-lb)

Performance: maximum speed 649 km/h (403 mph) at 3048 m (10,000 ft); patrol cruising speed 333 km/h (207 mph) at 2591 m (8,500 ft); ferry range 5930 km (3,685 miles)

Weights: empty 22650 kg (49,935 lb); maximum take-off 36240 kg (79,895 lb)

Dimensions: span 31.65 m (103 ft 10 in); length 27.84 m (91 ft 4 in); height 8.94 m (29 ft 4 in); wing area 92.90 m² (1,000 sq ft)

Armament: assortment of mines, depth charges, bombs and torpedoes can be housed in an internal weapons bay; underwing stores stations can accommodate additional ordnance including bombs and high-velocity aerial rockets



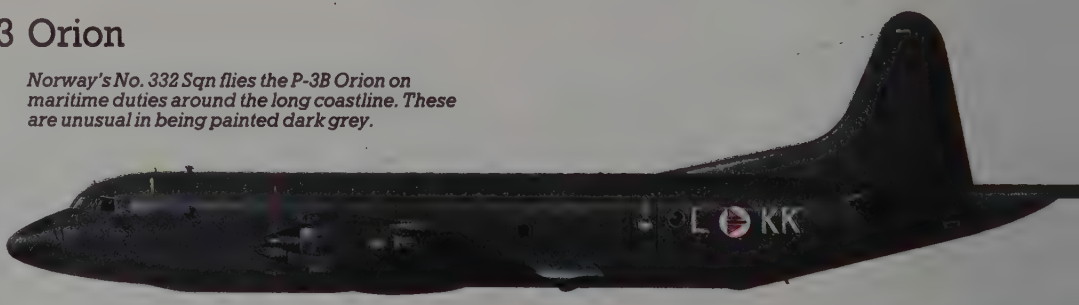
Still in service in large numbers with the air arm of the Japanese Maritime Self-Defence Force, the Lockheed P-2 has now been in service for almost four decades.

USA

Lockheed P-3 Orion

By August 1957 it appeared the Lockheed P-2 Neptune was coming to the end of its development, and the US Navy invited submissions for a replacement. Lockheed won with a patrol/ASW derivative of its **L-188 Electra** civil transport, the **Lockheed P-3 Orion** with airframe almost unchanged except for the addition of an unpressurized weapon bay ahead of the wing in a shortened fuselage, pylons for external stores and a MAD boom behind the tail. An aerodynamic prototype with these changes flew on 19 August 1958. The first production **P-3A** flew on 15 April 1961 and by 1983 Lockheed-California had delivered almost 600 P-3s of successively improved models. Most are regular maritime patrol aircraft but the US Navy uses **EP-3B** and **EP-3E** electronic-warfare platforms with giant canoe radars, **RP-3A** machines are special reconnaissance aircraft and four **WP-3A** aircraft fly weather missions. The standard 1985 model is the **P-3C Update III**, the various Update programmes having contributed improved sensors, data-processing, nav/com and other avionic systems. The Canadian Armed Forces bought 18 **CP-140 Aurora** aircraft which packaged the Lockheed S-3A sensors, avionics and data-processing systems into the P-3 airframe. Japan's 45 **P-3C Update II** aircraft comprise three flown from Lockheed, and four assembled and 38 licence-built by Kawasaki.

Norway's No. 332 Sqn flies the P-3B Orion on maritime duties around the long coastline. These are unusual in being painted dark grey.



Specification

P-3C Orion

Type: maritime patrol and ASW aircraft

Powerplant: four 3661.4-ekW (4,910-ehp) Allison T56-14 turboprops

Performance: maximum speed at a weight of 47628 kg (105,000 lb) 761 km/h (473 mph); maximum radius with no time on station 3835 km (2,383 miles)

Weights: empty 27891 kg (61,491 lb); maximum take-off 64410 kg (142,000 lb)

Dimensions: span 30.38 m (99 ft 8 in); length 35.61 m (116 ft 10 in); height 10.27 m (33 ft 8.5 in); wing area 120.77 m² (1,300 sq ft)

Armament: total expendable load 9072 kg (20,000 lb) comprising up to 3289 kg (7,252 lb) in internal bay (made up typically of two Mk 101 depth bombs, four Mk 44 torpedoes and numerous sensors/signals) plus underwing load on 10 pylons (maximum six 907-kg/2,000-lb mines)

The Canadian Armed Forces have bought 18 Lockheed CP-140 Auroras, these being standard P-3 airframes but with the electronic and sensor package found in the same company's S-3 Viking.

Lockheed Orion in Action

Developed from the Lockheed Electra airliner, the P-3 Orion has become the West's primary long-range ASW and maritime patrol aircraft. More than 550 Orions have flown since the late 1950s.

The P-3C variant of the Orion forms the backbone of the US Navy's shore-based ASW patrol force. This aircraft is from VP-5 (Patrol Squadron 5), usually based at Jacksonville, Florida.

The backbone of the US Navy's shore-based anti-submarine warfare and long-range patrol forces for more than 15 years, the Lockheed P-3 Orion has proved to be a most worthy successor to the same company's Neptune, and with production continuing at a modest rate for this service and for a number of overseas customers, the Orion looks like being around for a good many more years yet.

Based on the fairly successful Electra airliner, the Orion began development in earnest way back in August 1957 with the issue of Type Specification No. 146 by the Chief of Naval Operations, the Lockheed proposal being one of several submissions for this potentially lucrative project. Close study of these soon revealed that the P3V-1, as it was originally known, was by far the most suitable candidate, and Lockheed's initiative was rewarded in October 1958 by a contract covering procurement of long-lead-time items, this being rapidly followed by another for development of the sophisticated sensors and systems earmarked for installation in the new patrol aircraft.

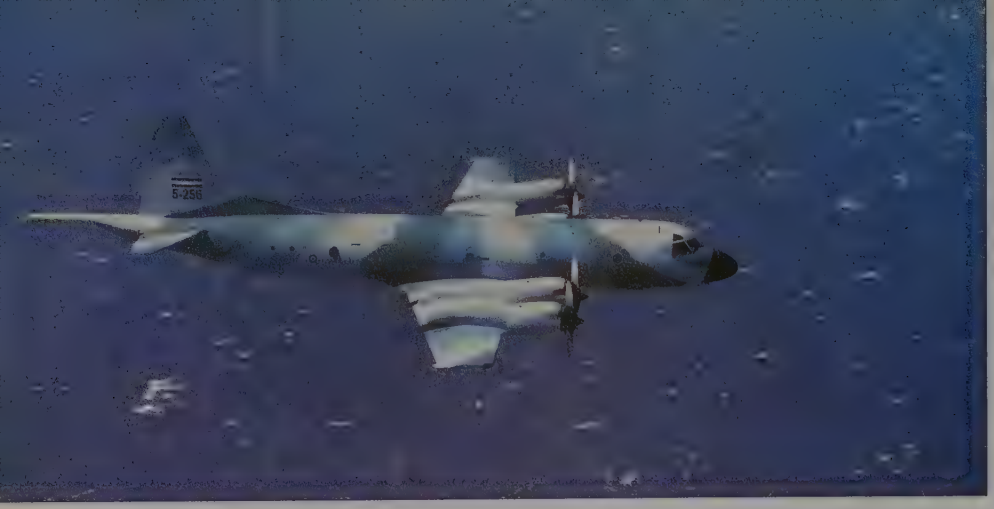
Representing a quantum leap in the anti-submarine warfare state of the art, the Orion was of necessity developed over a fairly protracted period, and it was not until August 1962 that the type entered service, the initial P-3A production model joining Patrol Squadron VP-8 at Patuxent River, Maryland. Subsequently, this and more capable later variants progressively replaced the P-2 Neptune and Martin P-5 Marlin that were rapidly becoming obsolescent. Today, all 24 operational US Navy patrol squadrons are equipped with either the P-3B or P-3C versions of the Orion, while a further 13 Reserve Force squadrons operate examples of the P-3A and P-3B. Other nations operating variants of the P-3 comprise Spain (P-3A), Japan (P-3C), the Netherlands (P-3C), Norway (P-3B), Iran (P-3F), Australia (P-3C), New Zealand (P-3B) and Canada (CP-140 Aurora). In the meantime, continuing development of the basic design has mainly centred around enhancing detection and data-processing capability, and the Orion of today is thus a very different beast from that which entered service more than 20 years ago.

Loitering capability

Possessing a maximum mission endurance in the order of 17 hours, the Orion is in many ways ideally suited to the special demands of ASW/patrol duties, enjoying reasonably fast en-route cruise speeds while also being able to loiter in the vicinity of a target or suspected target for as much as seven hours at distances of up to 1850 km (1,150 miles) from base. As far as offensive capability is concerned, the Orion has a capacious bomb bay which houses a variety of weapons such as mines, depth charges and torpedoes, further ordnance such as the AGM-84 Harpoon air-to-surface anti-shipping missile being carried under the wing on the latest production models. Since much of the Orion's mission is concerned with detection and surveillance of Soviet submarines, it follows that a large number of sonobuoys are also carried, these still being one of the prime sensor types employed in the three-dimensional game of 'hide-and-seek' to which ASW has been likened. On the P-3C some 48 size 'A' sonobuoys are carried in a bank of launch tubes situated beneath the fuselage just aft of the wing, these being loaded and unloaded from outside whilst the aircraft is on the ground, but there are also four launching tubes in the cabin for size 'A' and 'B' stores, adjacent racking permitting extra sonobuoys to be carried internally.

In the course of a typical mission, a single Orion can cover a vast expanse of water, and although the P-3 is most commonly associated with anti-submarine warfare, it should not be forgotten that much of the type's work is of a

On the bottom of the fuselage behind the wing of the P-3C can be seen the launch tubes for the 48 sonobuoys, which are loaded from the outside while the aircraft is at rest. Four tubes connect with the interior, and can be reloaded while in flight.



purely surveillance nature. Accordingly, a variety of sensor systems (including radar, sonobuoys and a magnetic anomaly detector) are employed by crew members, and all of these systems provide data directly to the central computer for processing and display via a number of cathode ray tubes located in the cabin and on the flight deck. By eliminating the need to perform mathematical calculations and routine record-keeping, the computer has truly revolutionized the ASW mission, perhaps the most significant benefit being that crew members can now direct their attention almost entirely to the developing tactical situation.

Of almost equal value is the fact that software relating specifically to a particular mission profile can also be prepared. Based on known navigation data and the latest intelligence reports, this software is loaded into the Orion's computer shortly before departure and once airborne can provide a reasonably accurate picture of the shipping situation likely to be encountered in the area under surveillance. Data-link facilities also enable up-to-the-minute information to be received or transmitted during the course of a mission, sources and recipients of such information being other ASW-dedicated aircraft and certain classes of surface vessel, the latter including aircraft-carriers.

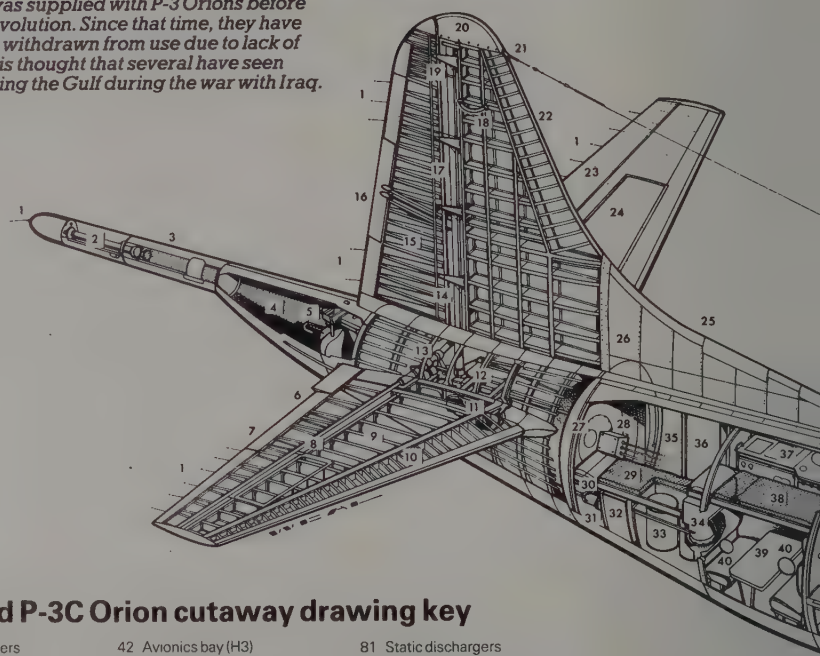
Once the Orion has reached its area of operations, the tactical co-ordinator's station becomes the focal point of mission-related activity, this station featuring a large display unit capable of providing either ground-stabilized or aircraft-centred readings. Depending on requirements, this multi-purpose display can present a variety of data including wind direction and velocity, sonobuoy positions, range scale (varying from 3.7 to 2224 km/2.3 to 1,382 miles), aircraft heading and ground speed, as well as range and bearing to suspected targets. All of this data is automatically stored on magnetic tape and can be analysed once the mission is completed and the aircraft has returned to base. Thus, for example, in a training exercise, the mission profile can be replayed, permitting crew members more or less to re-enact their mission and learn what they did right and, perhaps more importantly, what they did wrong.

Sensor inputs are managed by the tactical co-ordinator, who has the added bonus of being able to direct the course of flight by means of relaying fly-points to the flight director indicator in the cockpit.

As far as detection capability is concerned, radar is the principal sensor used to observe surface vessels, while sonobuoys (of both active and passive types) are mainly employed in the hunt for submarines. Another important sensor in the search for the latter is the MAD (magnetic anomaly detector), which notes and reports on such variations in the Earth's magnetic field as might be caused by the presence of a submerged vessel or wreck.

Stores management is also accomplished by computer, this being responsible for determining which sonobuoy will be launched and automatically selecting any one of 31 VHF channels used to monitor signals emanating from these sensors. Positional information pertaining to sonobuoys is also established by computer before display at the Tacco's station, and this device also looks after ordnance, selecting the weapon to be delivered and providing launch cues to the crew.

Above: Iran was supplied with P-3 Orions before the Islamic revolution. Since that time, they have steadily been withdrawn from use due to lack of spares, but it is thought that several have seen action patrolling the Gulf during the war with Iraq.



Lockheed P-3C Orion cutaway drawing key

1 Static dischargers
2 MAD detection head
3 MAD boom
4 Tail cone
5 APS-115 radar
6 Elevator trim tab
7 Starboard elevator
8 Elevator torque tube
9 Tailplane structure
10 Leading-edge hot air anti-icing
11 Elevator (starboard) and rudder (port) hydraulic booster units
12 Rudder linkage
13 Elevator tube universal joint
14 Rudder lower hinge
15 Rudder structure
16 Rudder trim tab
17 Rudder post
18 Antenna
19 Rudder upper hinge
20 Fin tip
21 Aerial attachment
22 Fin leading-edge
23 Port elevator
24 Port tailplane
25 Fin root fairing
26 Integral fin/rear fuselage
27 Aft pressure bulkhead
28 Tail unit anti-icing timer
29 Bunk (hinged: in-flight maintenance work bench beneath)
30 Elevator trim tab servo
31 Avionics bay (K2)
32 Avionics bay (K1)
33 Refuse bins (2)
34 KB-18 ventral camera (strike assessment)
35 Avionics bay (J2)
36 Avionics bay (J1)
37 Galley
38 Bunk (hinged)
39 Four-place dinette
40 Window ports
41 Lavatory
42 Avionics bay (H3)
43 Coat closet
44 Avionics bay (H2)
45 Avionics bay (H1)
46 Port observation station (screened compartment)
47 Starboard observation station (screened compartment)
48 Observation window
49 'A'-stores angle of release
50 'B'-store launchers (1)
51 'A'-store launchers (3)
52 Guard rail
53 Under-deck 'A'-store launchers (48)
54 Entry ladder (stowed in-flight position)
55 Main entrance door
56 Avionics bay (G2)
57 Avionics bay (G1)
58 Life-raft stowage (port)
59 Avionics bay (F2)
60 'A'-store stowage racks (36 stores)
61 Under-deck hydraulics service centre
62 Wingroot fairing
63 Ventral KA-74 camera
64 Avionics bay (F1)
65 Emergency exit (port)
66 Avionics bay (E2)
67 Avionics bay (E1)
68 Life-raft stowage (starboard)
69 Emergency exit (starboard)
70 Main electrical load centre (starboard)
71 Operators' seats
72 Sensor station 2 (acoustic)
73 Sensor station 1 (acoustic)
74 No. 2 fuel tank
75 Engine aft nacelles
76 Jet-pipe cooling-air inlets
77 Jet-pipe exhausts
78 HF aerial
79 Fowler-type flaps
80 Aileron trim tab
81 Static dischargers
82 Port aileron
83 Wingtip fairing
84 Port navigation light
85 Formation/identification light
86 No. 1 fuel tank
87 Integrally stiffened machined skin panels
88 Hot-air tapered ejector tubes ('piccolo' tubes)
89 Engine bleed air shut-off valve
90 Engine firewall
91 Nacelle cowling
92 Engine air intakes
93 Four-blade propellers
94 Spinners
95 Propeller cuffs
96 Oil cooler intake
97 ESM pod and pylon (mounted under port wingroot)
98 Oil cooler system
99 Engine oil cooling augmenter (jet pump) control valve
100 Starter control valve
101 Engine 14th stage bleed air taps
102 Engine bleed air shut-off valve
103 Fuselage bleed air shut-off valve (port and starboard)
104 Avionics bay (D3)
105 Sensor compartment centre-aisle curtain
106 Operator's seat
107 Window port
108 Sensor station 3 (non-acoustic)
109 Avionics bay (D2) (computer)
110 Avionics bay (D1)
111 Ditching station (13 places)
112 Avionics bay (B3)
113 Avionics bay (B2)
114 Avionics bay (B1)
115 Avionics bay (C3)
116 Avionics bay (C2)
117 Avionics bay (C1)
118 Observation window
119 Nav/com station
120 Bulkhead
121 Taco seat
122 Taco station
123 Antenna
124 Curtains/doorway to flight-deck
125 Flight crew emergency exit
126 Avionics bay (A1)
127 Pilot's seat
128 Flight engineer's seat
129 Overhead instrument console
130 Windshield
131 Instrument panel shroud
132 Control column
133 Forward pressure bulkhead
134 Radar support
135 Nose cone
136 APS-115 radar
137 Retractable FLIR
138 Pitot head
139 Nosewheel well beams
140 Rudder pedal

This brief look at some of the aspects of electronic wizardry available to the personnel who man the US Navy's large fleet of Orions might seem to indicate that they have not too much to do during a mission. Such an assumption would be erroneous, however, for the workload is still extremely high and ASW still has some way to go before it enters the totally automated age. Even then, it is highly unlikely that the number of aircrew members will decline, for there will probably always be a need for the old-fashioned 'mark one eyeball' which is still one of the most effective sensors around, while the human brain is streets ahead of even the most sophisticated computer when it comes to powers of reasoning.

Above: Typical of a day's work for the modern maritime patrol craft, this P-3B Orion of VP-17 was shadowing a Soviet 'Kynda' class guided missile cruiser. Often the first knowledge of new Soviet weapons comes from photos taken during such encounters.

141 Nosewheel retraction jack
142 Nosewheel doors
143 Forward-retracting twin nosewheels
144 Nosewheel leg torque link
145 Nosewheel leg pivot
146 Co-pilot's seat
147 Forward electrical load centre
148 Under-deck APU compartment
149 Under-deck weapons bay
150 Weapons bay doors
151 Bomb load (eight bombs)
152 Spinners
153 Four-blade propellers
154 Engine air intake
155 Intake trunking
156 Engine bearers ('V'-frame)
157 Oil tank
158 Inboard leading-edge section
159 Wingroot fillet
160 Fuselage fuel cell (no. 5 bag)
161 Water-alcohol tank
162 Wing centre-section front beam
163 Centre-section integral fuel tank (No. 5)
164 Centre-section end rib
165 No. 3 fuel tank
166 Flap structure
167 Jet-pipe exhausts
168 Flap profile
169 Bonded double skin
170 No. 4 fuel tank
171 Mainwheel well aft doors
172 Twin mainwheels
173 Mainwheel leg pivot
174 Retraction jack
175 Mainwheel well forward doors
176 Engine air intake
177 Propeller reduction gear box
178 Oil cooler intake
179 Engine support struts
180 Drive shaft housing
181 Allison T56-A-10 turboprop engine compressor section
182 Combustion section
183 Turbine section
184 Jet pipe
185 Stainless-steel heat-resistant trough
186 Aileron control linkage
187 Twin (fail-safe) trim actuators
188 Aileron trim tab
189 Static dischargers
190 Starboard aileron
191 Starboard navigation light
192 Formation/identification light
193 Rear spar
194 Integrally stiffened wing planks
195 Wing rib construction
196 Front spar
197 Leading-edge structure
198 Underwing stores pylons (three outboard, two inboard)

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Lockheed P-3C Orion Update II

Of the 26 land-based Maritime Patrol squadrons operational in the US Navy, 13 are Pacific-based, at Moffett Field, California, and at Barbers Point, Hawaii. The corresponding Atlantic Squadrons are based at the Naval Air Station, Jacksonville, Florida, and NAS Brunswick, Maine. This Lockheed P-3C Update II is assigned to patrol squadron VP-11 at Brunswick.

USA

Lockheed C-130 Hercules

Undoubtedly one of the most successful Western military aircraft of the post-war era, the **Lockheed Hercules** has been in continuous production since 1955 and the number built is now creeping up towards the 2,000 mark. Although designed primarily to fulfil airlift-type duties, the Hercules has proved to be a most versatile machine and presently undertakes such diverse tasks as inflight-refuelling, support of Antarctic exploration, weather reconnaissance, satellite capsule recovery, drone launch and control, airborne command post and search and rescue.

In addition to these missions, the Hercules has also proved to be well-suited for maritime applications. For the most part these are confined to surveillance and, indeed, the maritime Hercules lacks offensive capability although it is by no means beyond the realms of possibility that it could eventually be reconfigured in order to permit the carriage of dedicated anti-submarine warfare weaponry such as depth charges.

Based on the **C-130H**, which is the current production model of the Hercules, those aircraft intended for maritime tasks incorporate a number of detail changes, but the basic design can be more or less tailored to meet customer requirements. Optional equipment available includes a crew rest/galley module; a ramp equipment pallet containing rescue kit, a loudspeaker, flare launchers and an aft-facing observation platform; specialized sea search radar; advanced navigation equipment; searchlights; system interfaces for camera and data annotation gear; and observation stations in the cabin area. In addition, of course, the Hercules can also undertake airlift-type duties with equal facility, a factor which must be particularly attractive to those nations which have only limited funds available for the purchase of new equipment.

Above: Given the astonishing range of tasks it has performed in its 30-year career, it is hardly surprising that there should be a maritime surveillance version of the Lockheed Hercules. Used by Indonesia, the C-130H-MP can patrol for up to 16 hours at an altitude of 1525 m (5,000 ft).

Below: The US Coast Guard has more than 20 HC-130 Hercules, although some of the earlier models are in storage. The HC-130H is an extended range model originally used by the Air Force Aerospace Rescue & Recovery Service, with 12 subsequently produced for the US Coast Guard.

Specification

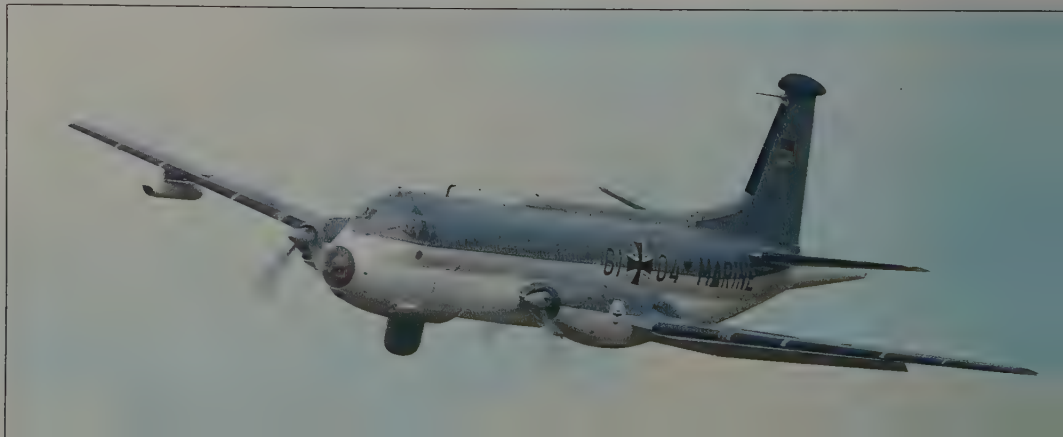
C-130H (maritime configuration)
Type: medium/long-range cargo/maritime surveillance aircraft
Powerplant: four 3361.6-kW (4,508-shp) Allison T56-A-15 turboprop engines
Performance: maximum cruising speed 621 km/h (386 mph); patrol range with auxiliary fuel at surveillance altitude of 1524 m (5,000 m) 4661 km (2,896 miles)
Weights: zero fuel in typical maritime configuration 39945 kg (88,064 lb); maximum normal take-off 70307 kg (155,000 lb); maximum overload take-off 79379 kg (175,000 lb)
Dimensions: span 40.41 m (132 ft 7 in); length 29.79 m (97 ft 9 in); height 11.66 m (38 ft 3 in); wing area 162.11 m^2 (1,745 sq ft)
Armament: none

FRANCE

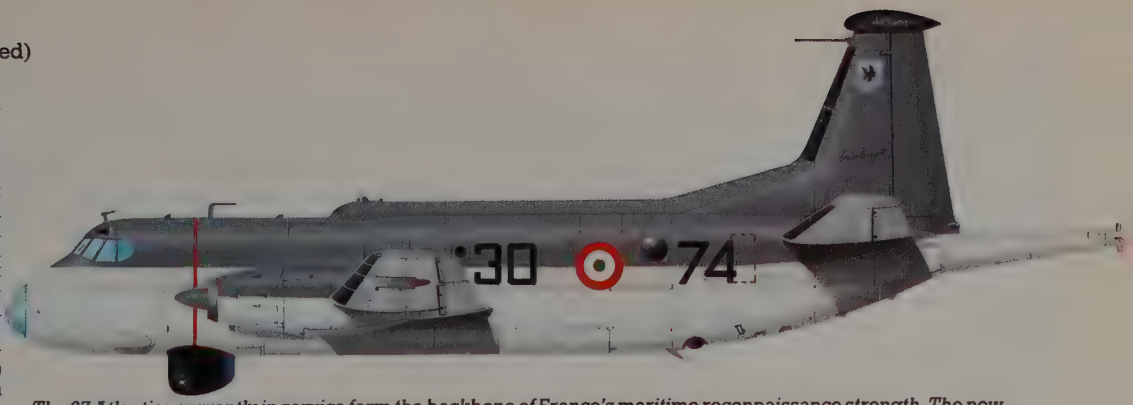
Dassault-Breguet Atlantic

The **Dassault-Breguet Atlantic** stemmed from the **Breguet Br 1150**, the winning design in a 1958 NATO contest for a new maritime patrol aircraft to succeed the Lockheed Neptune. Though the choice was approved by all 15 NATO members in December 1958, and ordered into production by a multinational consortium called SECBAT,

Manufactured by an international consortium to a French design, the Atlantic is only operated in any quantity by France, Germany and Italy. Germany operates 14 Atlantics in the maritime role, with five more aircraft being dedicated to Elint.



the Atlantic was bought by only a few countries, notably excluding the UK and the USA, and Belgium whose industry had a major share in SECBAT. Other partners, apart from the parent firm, were Sud-Aviation, Dornier and Fokker. Italy joined after placing an order, and the British engines and propellers were likewise shared out among participating nations. The prototype flew on 21 October 1961 and deliveries began in December 1965, totalling 87 for France (37), West Germany (20), Italy (18), Netherlands (9) and Pakistan (3). Skinned largely with aluminium honeycomb sandwich, the Atlantic has a capacious double-bubble fuselage, an efficient long-span wing, and comprehensive avionics managed by a crew of 12. Five German machines are ECM platforms. On 8 May 1981 Dassault-Breguet flew the first **ANG (Atlantic Nouvelle Génération)** with completely updated avionics and improved structure. France expects to buy 42 ANGs (now known as the **Atlantique**) made by the same SECBAT consortium, and other orders are being sought.



The 27 Atlantics currently in service form the backbone of France's maritime reconnaissance strength. The new Atlantique was first flown in May 1981, and 42 have been ordered by the Aéronavale. The new model features a strengthened structure and new avionics.

Specification
Atlantique
Type: maritime patrol and ASW aircraft
Powerplant: two 4638.3-ekW (6,220-ehp) Rolls-Royce Tyne 21 turboprops made by multinational group
Performance: maximum speed at sea level 592 km/h (368 mph), and at 6096 m (20,000 ft) 658 km/h (409 mph); range 8150 km (5,065 miles); endurance 18 hours
Weights: empty 25300 kg (55,777 lb); maximum take-off 46200 kg (101,854 lb)
Dimensions: span (over ESM pods) 37.30 m (122 ft 4.5 in); length 32.62 m (107 ft 0.25 in); height 11.35 m (37 ft 2.9 in); wing area 120.34 m^2 (1,295.3 sq ft)
Armament: unpressurized weapon bay houses all NATO bombs, torpedoes (8), depth charges, mines and missiles, a typical load being one AM39 Exocet plus three AS torpedoes; four wing pylons for 3500 kg (7,716 lb) of stores including pods, containers, rockets or ASMs

JAPAN

Shin Meiwa PS-1 and US-1

Today the great fleets of military flying-boats and amphibians have all but vanished, and the only type recently in production is the **Shin Meiwa SS-2** family which was produced as the **PS-1** and **US-1** for the JMSDF (Japan Maritime Self-Defence Force). The company was famed as that wartime builder of marine aircraft, Kawanishi, and when it received a 1966 contract for an ASW (anti-submarine warfare) flying-boat it produced a very advanced design with four turboprops for propulsion and a fifth gas turbine to provide high-pressure air for boundary-layer control blowing over the flaps, rudder and elevators. This enables the aircraft to fly extremely slowly under full control and also greatly reduces take-off and alighting distances. The first SS-2 (PS-1) flew in October 1967, and eventually 23 production machines were delivered, 19 of these remaining operational with the JMSDF 31st Air Group at Iwakuni. The PS-1 has a crew of 10, comprising two pilots, flight engineer, navigator, two sonar operators (sonar can be repeatedly dipped in rough seas after alighting), MAD operator, radar and radio operators and tactical co-ordinator. A beaching chassis is permanently attached and the PS-1 can taxi ashore under its own power. The **SS-2A** amphibian, on the other hand, has full tricycle landing gear, and eight were delivered as US-1 search/rescue aircraft with a crew of nine and room for either 20 seated survivors, 12 stretcher (litter) casualties or 69 ordinary passengers.

Whilst on patrol the PS-1 makes repeated landings and take-offs, dipping its sonar after alighting. This can be accomplished in seas with up to 3 m (10 ft) waves.

Specification
PS-1
Type: ASW flying-boat
Powerplant: four 2281.8-ekW (3,060-ehp) General Electric T64-IHI-10 turboprops (made under licence by IHI)
Performance: maximum speed 547 km/h (340 mph); range at low altitude with maximum weapons 2168 km (1,347 miles)
Weights: empty 26300 kg (57,982 lb); maximum 43000 kg (94,799 lb)
Dimensions: span 33.14 m (108 ft 8.7 in); length 33.50 m (109 ft 10.9 in); height 9.71 m (31 ft 10.3 in); wing area 135.82 m^2 (1,462 sq ft)
Armament: internal weapon bay for four 149-kg (328-lb) AS bombs and extensive search gear, two underwing pods for four Mk 44 or 46 homing AS torpedoes and triple launcher under each wingtip for 127-mm (5-in) rockets

A highly advanced wing and engine combination gives the Shin Meiwa PS-1 and the amphibious US-1 very good STOL and low speed handling capabilities.

UK

British Aerospace Nimrod

After many years studying other ideas, the RAF picked the **British Aerospace Nimrod** as its replacement for the Avro Shackleton in the maritime patrol role, and the first production **Nimrod MR.Mk 1** flew on 28 June 1968. Features include an enormously capacious fuselage with a very large unpressurized lower lobe housing the radar, weapon bays and much systems equipment. Flight is possible on any one of the four fuel-efficient turbofan engines, the outers having reversers to back up the anti-skid brakes on the bogie main gears and enormous plain flaps. The normal crew comprise 12, who have an outstandingly complete and well integrated array of sensors, data processing and navigation/communication/identification systems for ASW, SAR, Elint, reconnaissance and other tasks for surface forces and even transport with accommodation for 45 passengers in the rear compartment. The 43 Nimrod MR.Mk 1 aircraft established an outstanding record, only one being lost in 10 years of intensive operation, mainly in extremely adverse conditions and at very low levels.

Nimrod's latest MR.Mk 2P guise has a hemp colour scheme and an inflight-refuelling probe added.

Three **Nimrod R.Mk 1** aircraft serve in the dedicated Elint role. From 1979 a total of 32 Nimrod MR.Mk 1s have been rebuilt as **Nimrod MR.Mk 2** with completely upgraded avionics, sensors and data-processing. A total of 11 further aircraft are being delivered as **Nimrod AEW.Mk 3** AWACS type aircraft, with Marconi pulsed-Doppler surveillance radar of extremely advanced type using nose and tail aerials each scanning 180° with perfect visibility. The Nimrod AEW.Mk 3 is compatible with all E-3A Sentries and should enter service with No. 8 Squadron, RAF, in 1986.

Specification

Nimrod MR.Mk 2

Type: maritime patrol aircraft

Powerplant: four 5507-kg (12,140-lb) thrust Rolls-Royce Spey 250 turbofans

Performance: maximum speed 926 km/h (575 mph); patrol speed on two engines 370 km/h (230 mph); range 9262 km (5,755 miles); endurance 18 hours

Weights: empty 39009 kg (86,000 lb); maximum take-off 87090 kg (192,000 lb)

Dimensions: span 35.0 m (114 ft 10 in); length 38.63 m (126 ft 9 in); height 9.06 m (29 ft 8.5 in); wing area 197 m^2 (2,121 sq ft)

Armament: 14.78 m (48 ft 6 in) weapon bay carries six lateral rows of stores including nine torpedoes as well as bombs; provision for wing pylons for ASMs or other stores; very comprehensive ASW sensor systems

Nimrods were given a limited self-defence capability during the Falklands campaign by the addition of AIM-9L Sidewinders under the wings; these were also to be used against Argentine Boeing 707s which were patrolling the same oceans. This aircraft is an MR.Mk 2P with inflight-refuelling probe.

UK

Pilatus Britten-Norman Maritime Defender

The British firm Britten-Norman flew a prototype of the highly successful **Britten-Norman BN-2 Islander** nine-passenger light transport in 1965. A rugged aircraft with fixed landing gear, it has also been produced in the Philippines, Romania and Belgium, although the parent company at Bembridge, Isle of Wight, is now Swiss-owned. Several air arms adopted the Islander for personnel and freight transport, including five delivered to the Indian Navy in 1976. Later, these aircraft were modified with a nose-mounted radar for maritime patrol duties, being augmented in 1981-3 by a further dozen to the same standard. Similarly, the Philippine navy operates five locally-built Islanders in the surveillance role.

The next stage in development was the **Defender**, built to military standards and with optional fitments including four underwing weapon pylons and a weather radar in the nose to provide a simple maritime-search capability. Low cost has resulted in considerable sales, especially to Third World countries. To meet the specialized maritime requirement more fully, the manufacturer has introduced the **Maritime Defender**, the main feature of which is a Bendix RDR 1400 radar providing an enhanced search range: 67 km (41.5 miles) for a 100-m^2 (1,076-sq ft) object in sea state 4-5. The nose radome increases fuselage length from the standard 10.86 m (35 ft 7.75 in), and the antenna scans 60° to each side, giving a search band of 111 km (69 miles) at optimum altitude. For day or night operations in coastal patrol, fishery protection and SAR roles, the aircraft carries a pilot, a co-pilot, a radar operator and two observers, together with such aids as Omega navigation, a radio altimeter and a transponder. Wing pylons are retained for SAR kits as well as more warlike loads such as BAe Sea Skua anti-ship missiles, Marconi Stingray homing torpedoes, self-defence AIM-9 Sidewinder AAMs and a range of ECM/ESM pods. An optional searchlight and hand-held camera are available for fishery and other policing tasks. Customers may opt for the **Turbine Defender** version, powered by two 238.6-kW (320-shp) Allison 250-B17C turboprop engines.

Specification

Maritime Defender

Type: armed maritime surveillance aircraft

Powerplant: two 193.9-kW (260-hp) Avco Lycoming O-540-E4C5 flat-six piston engines

Performance: maximum speed, clean 280 km/h (174 mph); initial climb rate 396 m (1,300 ft) per minute; service ceiling 5182 m (17,000 ft); range with maximum payload 673 km (418 miles)

Weights: empty 1823 kg (4,020 lb); maximum take-off 2994 kg (6,600 lb)

Dimensions: span 14.94 m (49 ft 0 in) standard, or 16.15 m (53 ft 0 in) optional; length 11.07 m (36 ft 3.75 in); height 4.18 m (13 ft 8.75 in); wing area 30.19 m^2 (325.0 sq ft) or 31.31 m^2 (337.0 sq ft)

Armament: various missiles and bombs on four underwing pylons

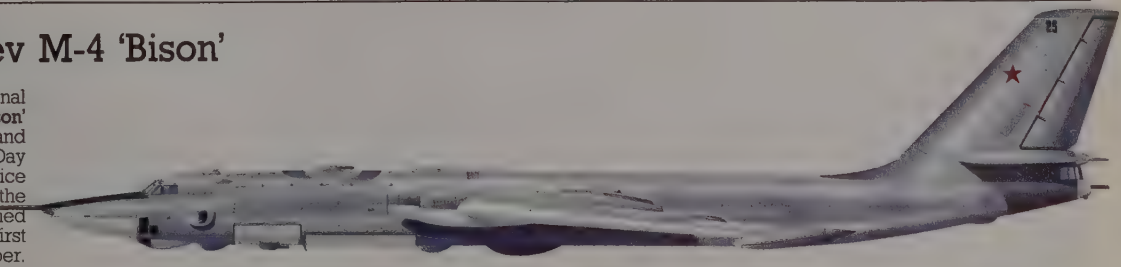
Pilatus Britten-Norman's Defender provides a low-cost alternative for a maritime aircraft. This example flies with the Benin Defence Force on maritime duties, armed with torpedoes under the wings.

USSR

Myasishchev M-4 'Bison'

Now in the twilight of its operational career, the **Myasishchev M-4 'Bison'** entered the design stage in 1951 and was first seen airborne in a May Day flypast over Moscow in 1954. Service deliveries began in 1956, and with the nickname **'Molot'** (hammer) it gained the distinction of being the USSR's first operational four-jet strategic bomber. V.M. Myasishchev had previously been a leading light in the Tupolev bureau, and this product emerged as a robust, yet innovative aircraft which met most aspects of an extremely demanding strategic bomber specification. Similar in many respects to early models of the Boeing B-52, the **'Bison-A'** numbered among its achievements a world record speed 1028 km/h (639 mph) in a 1000-km (621-mile) closed circuit carrying a 27000-kg (59,525-lb) payload. Perhaps 200 of the type were built, of which 40 remain as bombers and 30 have been fitted as inflight-refuelling tankers.

A maritime version, the **'Bison-B'** was first observed in 1964, being distinguished by a solid nose radome with attached inflight-refuelling probe, a bulge in the forward portion of the centre bomb bay doors, and a comprehensive sensor fit betrayed by several blister fairings beneath the fuselage. The original upper and lower rear fuselage gun turrets were removed, leaving six NR-23 cannon for self-defence. The improved **'Bison-C'** continued the MR theme, but its improved search radar was contained in a new, longer nose and a prone bombing position with an optically flat windscreen was added in the floor of the cockpit. In addition, more small windows and a domed observation and gun-aiming position were added to each side of the fuselage, although the belly retained the same modification as the 'Bison-B'. As such, the 'Bison-C' version is available for reconnaissance, Elint, electronic warfare and mid-course guidance of long-range anti-ship missiles. The 'Bison-A' and perhaps a small number of 'Bison-Bs' and 'Bison-Cs' of the Soviet naval air force remain in use.



'Bison-C' is the main maritime version of the M-4, which features an elongated nose containing more capable radar. 'Bison-B' was the earlier maritime version.

Specification

M-4 'Bison-C'

Type: maritime reconnaissance bomber

Powerplant: four 13000-kg (28,660-lb) thrust Soloviev D-15 turbojets

Performance: maximum speed 1005 km/h (624 mph) or Mach 0.945 at 11000 m (36,089 ft); unrefuelled radius of action 5600 km (3,480 miles)

Weights: empty about 83900 kg (184,968 lb); maximum take-off 210000 kg (462,971 lb)

Dimensions: span 52.50 m (172 ft 2.9 in); length excluding probe 49.38 m (162 ft 0 in); height 14.24 m (46 ft 8.7 in); wing area 320.0 m^2 (3,444.6 sq ft)

Armament: six NR-23 23-mm cannon in dorsal, tail and ventral barbettes

The Mysasishchev M-4 heavy bomber, known by the NATO reporting name 'Bison', was the first Soviet four-jet operational heavy bomber. With an unrefuelled combat radius of over 5600 km (3,480 miles), it proved suitable for the maritime reconnaissance and attack roles, and two dedicated MR versions were produced.

USSR

Tupolev Tu-16 'Badger'

Bearing the Tupolev designation Tu-88, this strategic jet bomber first flew in late 1952. **'Badger-A'** bomber versions were in service by 1954 and these were followed by **'Badger-B'** and **'Badger-G'**, which could carry two stand-off air-to-surface missiles under the wings. **'Badger-C'** is an anti-shipping version with a 'Kipper' missile carried in a recess under the fuselage (some now have pylons for 'Kingfish' missiles under the wings). There have been many maritime reconnaissance, Elint and ECM variants: the **'Badger-D'** maritime reconnaissance platform with large undernose radar, **'Badger-E'** with cameras in bomb bay, **'Badger-F'** with Elint pods carried under the wings, **'Badger-H'** specialist ECM aircraft with primary chaff-dispensing function, **'Badger-J'** specialist electronic jamming aircraft and **'Badger-K'** electronic reconnaissance aircraft. All these versions are widely seen around Western naval forces, and also make electronic intelligence flights around the coasts of NATO countries, eavesdropping on communications. Support is provided by Tu-16 tankers, which refuel other 'Badgers' by the wingtip-to-wingtip method. About 400 Tu-16s remain in service with the AV-MF (naval aviation).

Specification

Type: strategic bomber, missile platform, maritime reconnaissance, ECM and Elint aircraft

Powerplant: two 8700-kg (19,200-lb) Mikulin AM-3M turbojets

Performance: maximum speed 1000 km/h (620 mph); cruising speed 850 km/h (530 mph); service ceiling 14000 m (46,000 ft); maximum range 6400 km (4,000 miles)

Weights: empty 3600 kg (80,000 lb); maximum take-off 72000 kg (158,500 lb)

Dimensions: wing span 34.54 m (113 ft 3 in); length 36.5 m (120 ft); height 10.8 m (35 ft 6 in); wing area 170 m^2 (1,820 sq ft)

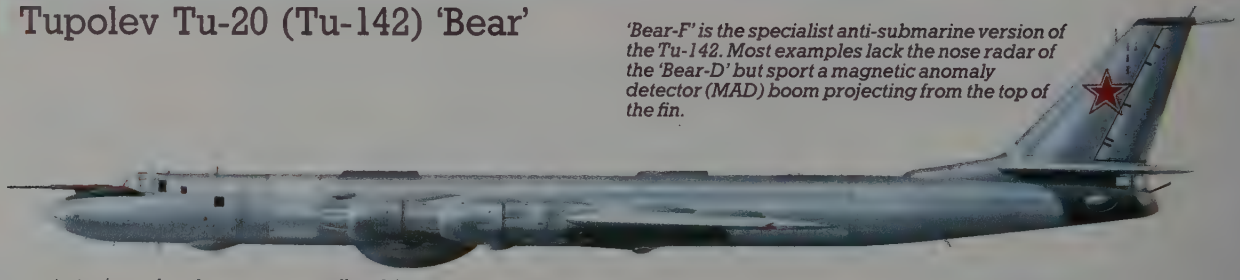
Armament: all versions have seven 23-mm NR-23 cannon: one fixed in forward fuselage, two in tail turret and two each in ventral and dorsal barbettes; ('Badger-C') one AS-2 'Kipper', ('Badger-G') two AS-5 'Kelt' or one AS-6 'Kingfish' air-to-surface missiles; bomber versions have provision for 6000 kg (13,000 lb) of internal stores

Anti-shipping and reconnaissance versions of the Tu-16 are widely seen around NATO ships and coastlines. This 'Badger-C' carries a large radar under the nose, and has pylons under the wings for anti-ship missiles.

USSR

Tupolev Tu-20 (Tu-142) 'Bear'

'Bear-F' is the specialist anti-submarine version of the Tu-142. Most examples lack the nose radar of the 'Bear-D' but sport a magnetic anomaly detector (MAD) boom projecting from the top of the fin.



Designed as a strategic nuclear bomber, the **Tupolev Tu-20** first flew in 1954 and was initially regarded in the West as an aircraft of little promise. Having the design bureau project number **Tu-95**, it was essentially a swept-wing version of the Tu-85 with four turboprop engines driving contra-rotating four-blade propellers of massive 5.6 m (18 ft 4.5 in) diameter. At a time when turbojet bombers were proliferating, the engine configuration caused the design to be assessed as obsolescent, and not until later did the West appreciate the remarkable range and bombload capabilities of the aircraft. Accommodating up to 16 personnel, comprising two crews, the Tu-20 received the NATO reporting name **'Bear'** and was found to be capable of flying over 160 km/h (99 mph) faster than the supposed maximum speed for a propeller driven aircraft of its size.

Main production of the 'Bear' ended in 1961-2 after approximately 300 aircraft, although a dozen or so were produced annually for the next 20 years to maintain force levels. Currently, the Soviet air force (V-VS) has about 115 Tu-20s (a little more than half the remaining aircraft) of the **'Bear-A', 'Bear-B', 'Bear-C'** and **'Bear-G'** variants for free-fall bombing or carrying cruise missiles. Production of new **'Bear-H'** aircraft at the Taganrog plant began recently in order to provide a carrier for the AS-15 cruise missile.

Maritime reconnaissance versions of the 'Bear' have the bureau designation **Tu-142**, this number having been revived and used in preference to Tu-20 in order to identify naval models exempt from the 1979 SALT-2 arms-control talks. These comprise 45 **'Bear-D'** aircraft with a large I-band radome under the belly; a small number of **'Bear-E'** aircraft equipped with cameras in the bomb bay; and 50 **'Bear-F'** aircraft for anti-submarine duties. The last-mentioned is a revised design with changes including a 2.00 m (6 ft 6.75 in) fuselage extension forward of the wings. Other 'Bears' have been noted with a variety of special sensor equipment fitments and three, designated **Tu-142M**, are due for delivery to the Indian Navy in 1985 for ASW duties as the sole exports of the Tu-20 series. Despite its age, the 'Bear' remains an effective reconnaissance aircraft and will continue to serve Soviet naval aviation (AV-MF) for some time to come. Western observers speculate that its 'replacement' could prove to be a prop-fan version of the same basic design.

Specification

Tu-20 (Tu-142) 'Bear-F'

Type: long-range maritime reconnaissance aircraft

Powerplant: four 11032.6-kW (14,795-shp) Kuznetsov NK-12MV turboprops

Performance: maximum speed 925 km/h (575 mph) at 12500 m (41,010 ft); maximum unrefuelled range (bomber) 12550 km (7,798 miles)

Weight: maximum take-off about 188000 kg (414,469 lb)

Dimensions: span 51.10 m (167 ft 7.8 in); length 49.50 m (162 ft 4.8 in); height 12.12 m (39 ft 9.2 in); wing area 310.5 m^2 (3,342.3 sq ft)

Armament: two NR-23 23-mm self-defence cannon in tail turret, plus depth charges, bombs and torpedoes.

Shadow of the Bear

In production for over 30 years, the giant Tupolev design known as the 'Bear' has become a familiar sight over the oceans of the world. There can be few sailors who have taken part in a large exercise who have not felt the shadow of the 'Bear'.

Below: A plan view of the 'Bear-D' shows the unique configuration of swept wing and massive turboprop engines driving four enormous sets of contra-rotating propellers.

The bear is, in its animal form, often used to represent the Soviet Union, and so it was perhaps fitting that NATO allocated the reporting name 'Bear' to Tupolev's Tu-20 bomber when it first appeared in the mid-1950s. Like the USSR, the 'Bear' is a giant; and in apparent confirmation of Western opinions of its country of origin, it appeared to be a backward design. Now, over three decades later, the immense range capability of the 'Bear', even without use of its inflight refuelling probe, has pressed home the fact that it is still a valuable asset in maritime reconnaissance. Like Soviet influence, 'Bears' will be found throughout the globe and, indeed, the aircraft is partly responsible for the USSR's current presence at strategic points on and under the world's oceans.

Although used by the Soviet air force from late 1956 as a strategic bomber (and later as a cruise missile carrier) the 'Bear' was not positively identified in naval guise until 1967, when two overflew US Coast Guard vessels in the Arctic. Designated 'Bear-D', these were seen to have an immense I-band search radar scanner beneath the belly, this being christened 'Big Bulge' by the NATO Air Standards Coordinating Committee. The name was appropriate, for this was the largest radar carried aloft until the advent of AWACS aircraft. Among a plethora of other electronic sensors and aerials, the 'Bear-D' has a 'Short Horn' navigation (with bombing capability) J-band radar below the extreme nose, while in some sub-variants the tail turret is replaced by further electronic equipment. About 45 'Bear-Ds' remain in service, one of their main tasks being to pinpoint targets for missiles launched by ships or aircraft too far away to locate the enemy with their own radars.

The 'Bear-E' is a rebuild of the 'Bear-A' for strategic reconnaissance, incorporating an in-

Below: 'Bear-D' is the most seen version over international waters, and frequently undertakes flights in the North Atlantic, flying from its bases on the Kola Peninsula to airfields in Cuba. These are frequently intercepted by the F-4E Phantoms of the 57th Fighter Interceptor Squadron from Iceland.

flight-refuelling probe, six (occasionally seven) cameras in the bomb bay, and electronic sensors. Finally, in 1973, the 'Bear-F' was identified. This is a long-range anti-submarine version featuring a lengthened fuselage, a revised flightdeck with raised canopy, a smaller I-band radome mounted further forward than on the 'Bear-D', only optional fitment of J-band radar in a modified undernose housing, and a comprehensive array of sonic processing equipment. Some 50 of this version are in use.

With its immense size, long range and respectable turn of speed, the 'Bear' was ideally suited to the patrol of vast ocean tracts far from base. The foundation of this work was laid in Nikita Khrushchev's announcement in January 1960 of a new military doctrine in which the submarine would take pride of place amongst naval weaponry, followed by the AV-MF (Naval Aviation), with surface vessels and other units assigned lesser importance. As the fleet has grown from a coastal protection force into a 'blue water navy', so has the 'Bear' increased its surveillance activities from an ever larger number of bases.

Defensive patrols

In the defensive role, however, 'Bears' patrol the waters around the Soviet Union on the lookout for foreign ships and submarines, just as would any naval air force. The aircraft also keep watch over the regular exercise areas of the Soviet navy, although possibly they have little to do with the Black Sea and Baltic Fleets which operate in the restricted home waters that can be covered by the Ilyushin Il-38 'May'. More extensive operational areas are enjoyed by the Pacific and Northern Fleets, the latter being responsible for the 12000-km (7,456-mile) Arctic coastline and operation of the greater proportion of the USSR's nuclear submarines.

Operating from Murmansk, the Northern Fleet includes the waters off Norway as its training ground, while elements regularly enter the North Atlantic via the Iceland-Faroes gap, this being the fleet's expected main thrust line in wartime. 'Bears' flying from bases on the Kola peninsula as part of the 425-strong naval air element of the Northern Fleet support these operations. The position in the Pacific is much the same, with patrols being regularly undertaken of the Bering and Okhotsk Seas as well as the more sensitive Sea of Japan. Some 440 naval aircraft of all types are based in this area, 'Bears' included.

But 'Bears' are also to be seen over waters not immediately relevant to defence of the Soviet Union. Surveillance of shipping movements and gathering electronic intelligence over a wide area are essential activities for any major power, as is the tangible provision of support for friendly Marxist states in Central America, Africa and South East Asia. When RAF fighters are scrambled to intercept an unknown aircraft flying towards the North Sea or through the Iceland-Faroes gap, the target is as likely as not to be identified as a 'Bear' on a regular surveillance flight. Special sorties are flown when there is a NATO naval exercise to be observed, while other intercepts may be of 'Bears' going to and from rotational duty in Cuba.

The Castro regime in Cuba has provided the USSR with an ideal location from which to observe the eastern seaboard of the United States and to support Marxist movements in Central America. On average, six 'Bears' are based at San Antonio, south of Havana, from where they can co-operate with Soviet ships regularly deployed in the Gulf of Mexico. 'Bear-Ds' arrived in November 1981, being joined by the ASW 'Bear-Fs' from early-1983 onwards. The latter are deployed to the area apparently to track US nuclear-armed submarines leaving eastern ports. These aircraft form half the South Atlantic surveillance force, the balance coming from the African mainland at Luanda in Angola. Together, the two 'Bear' units can watch the ocean from the Mediterranean approaches to the US coast and down as far as the Cape of Good Hope. Luanda-based 'Bears' conducted limited monitoring of the British task force and its reinforcements during the Falklands war of 1982.

Soviet ships have increased their activities in the Indian Ocean where, inevitably, the 'Bear' is expected to appear in due course, augmenting shorter-range 'Mays' flown from Ethiopia and South Yemen. If 'Bear-Ds' were deployed at Aden in South Yemen, they could reconnoitre the waters as far as the American rapid deployment base at Diego Garcia. Perhaps more galling to the USA is the fact the 'Bears' are now flying from its former base at Cam Ranh, Vietnam, in support of the 25 or so Soviet ships operating in the South China Sea. First arrivals in this region, at Da Nang in April 1979, were two 'Bear-Ds' for surveillance, followed in January of the next year by two ASW 'Bear-Fs', these four aircraft moving to Cam Ranh in June 1980. This was the first occasion on which the two complementary 'Bear' models were seen operating together outside the USSR, although the pattern was soon to be repeated in Cuba.

The importance of the 'Bear' deployment was stressed in November 1983 when 10 Tupolev Tu-16 'Badger' jet bombers arrived at Cam Ranh. Tasked with anti-shipping strike, the 'Badgers' would rely on their compatriots for target location, and there has been speculation that a regiment of 25 'Badgers' will eventually be based in Vietnam. Reinforcement or replacement of these aircraft caused a diplomatic incident late in November 1984, when numbers of both types passed through Japanese airspace during their ferry flights.

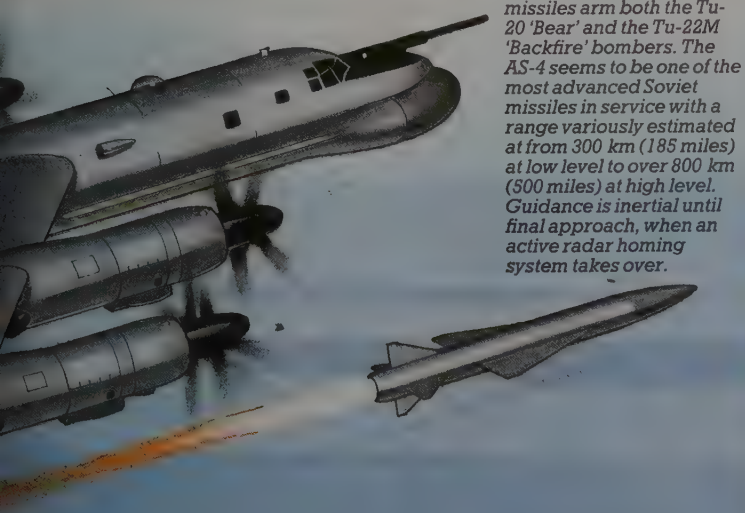
Few areas of naval importance are now outside the reach of 'Bears' flying from home terri-

The Shadow Strikes

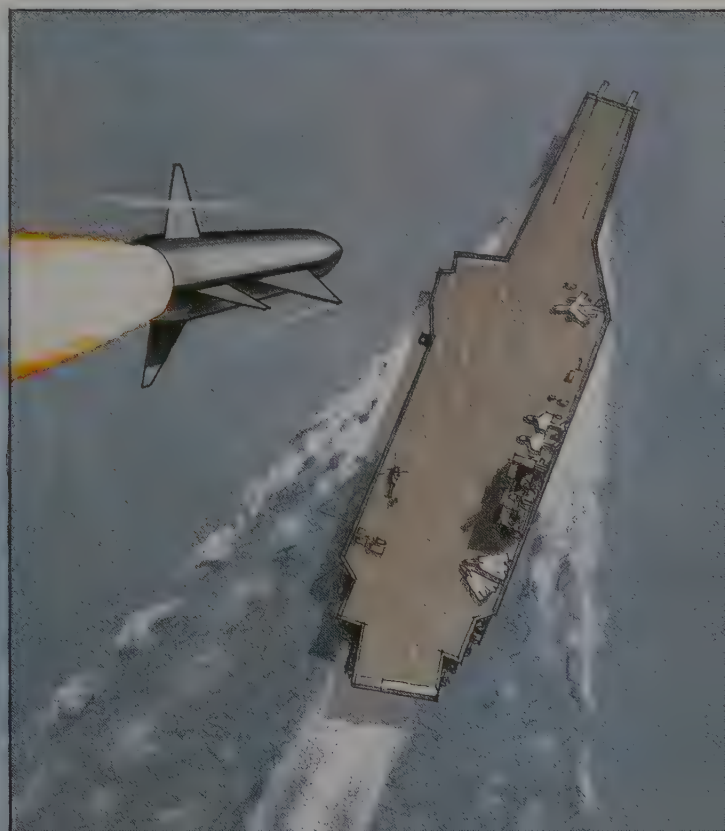
The 'Bear-C' is a strike version of the Tu-95 design, easily identifiable from the maritime reconnaissance versions by the much larger chin radome. Its primary maritime function in time of war would be to attack high value naval targets, such as a carrier battle group, in conjunction with surface and submarine forces.

tory or from the airfields of countries friendly to Moscow. In the absence of aircraft operating from large carriers, 'Bears' have provided the USSR with the means to observe the world's shipping lanes and its military traffic, providing vital intelligence to augment that gathered from satellites, ships and submarines. Aerial surveillance is essential for the protection and effective operations of a modern naval force, and in that sense the 'Bear' may be said to have led the Soviet navy out into the oceans of the world.

Above: Intercepted in 1978, this 'Bear-D' has a faired-in tailcone in place of the rear gun turret. This fairing is thought to house yet more electronic sensors for its role of maritime surveillance and over-the-horizon missile targeting.



Left: AS-4 'Kitchen' missiles arm both the Tu-20 'Bear' and the Tu-22M 'Backfire' bombers. The AS-4 seems to be one of the most advanced Soviet missiles in service with a range variously estimated at from 300 km (185 miles) at low level to over 800 km (500 miles) at high level. Guidance is inertial until final approach, when an active radar homing system takes over.



Right: Soviet missiles have a range of options when approaching a target. Some may be programmed to attack at low level, although few have genuine sea-skimming ability. A favourite tactic, however, is a high-speed high-level run diving vertically down on the target. For a high-value target such as an aircraft carrier it is probable that a low-yield nuclear warhead would be used.

USSR

Beriev Be-12 Tchaika 'Mail'

One of the world's few remaining amphibious aircraft, the **Beriev Be-12** medium-range patroller is a record-holder par excellence, having swept the board of all 22 distinctions in FAI Class C2 (turboprop flying-boats) and another 22 in Class C3 (turboprop amphibians). Despite these achievements, the aircraft is not a special trials model, but in regular service with the Soviet Northern and Black Sea Fleets, being responsible for anti-submarine and surveillance duties out to some 370 km (230 miles) from shore. An ungainly aircraft, the Be-12 was appropriately named **Tchaika** (seagull) by reason of its gull wing, mounting the engines at the highest point to keep the propellers clear of spray at take-off and landing.

Developments took place during the late 1950s with the intention of replacing the Be-6, and the NATO name **'Mail'** was bestowed following the type's debut at the 1961 Aviation Day display at Tushino, Moscow. Service entry took place around 1965, and at least 100 were delivered before production ended in the early 1970s, about 80 of them continuing to provide naval aviation with a valuable asset. Prominent equipment for the main anti-submarine role are the 'Short Horn' J-band radar in the nose for long-range search and bombing, and a tail-mounted MAD boom. Depth charges and other stores can be released through a hatch in the lower hull, behind the step. Other equipment, such as torpedoes, may be attached externally on two pylons outboard of each engine. At least five crew members are carried, comprising a pilot, co-pilot, engineer, radar/ESM operator and ASW operator (and up to nine when a visual search is to be undertaken). The aircraft also appears to be used for electronic intelligence missions, particularly over the Baltic. Operating from coastal bases, the Be-12 uses a tailwheel landing gear, the main units of which fold upwards into the hull, although the tips of the wheels remain visible. Stabilizing floats mounted close to the wing tips are fixed. Be-12s ceased operation from Egypt in EAF insignia when that country distanced itself from the USSR, but since 1981 up to a dozen have been delivered to Vietnam (apparently still Soviet-crewed) for missions over the South China Sea. The type is also known as the **M-12**.

Known to the Soviets as the M-12, the Beriev Tchaika (Seagull) is one of the last amphibians to see large-scale military use, for purposes from ASW to electronic intelligence.

Specification

Be-12 'Mail'
Type: amphibious maritime patrol aircraft
Powerplant: two 3124.8-ekW (4,190-ehp) Ivchenko AI-20D turboprops
Performance: maximum speed 608 km/h (378 mph); initial climb rate 910 m (2,986 ft) per minute; service ceiling 11280 m (37,008 ft); maximum range 4000 km (2,485 miles)
Weights: empty about 20000 kg (44,092 lb); maximum take-off about 29450 kg (64,926 lb)
Dimensions: span 29.71 m (97 ft 5.7 in); length 30.17 m (98 ft 11.8 in); height 7.00 m (22 ft 11.6 in); wing area 105.0 m^2 (1,130.2 sq ft)
Armament depth charges, torpedoes and bombs carried internally or on four wing pylons.

USSR

Ilyushin Il-38 'May'

Ilyushin's Il-18 turboprop was one of the most successful Soviet passenger liners, with enormous production and exports, including many used by air forces. In about 1967 his design bureau flew the first **Il-38** ASW conversion, very similar to that effected by Lockheed to produce the P-3 Orion, though in Ilyushin's case the internal equipment resulted in a remarkable forward shift of the wing. The original circular-section pressurized fuselage is slightly lengthened and the windows replaced by a few small ports, and shallow weapon bays are added ahead of and behind the low-mounted wing. The forward shift of the wing may have been in order to leave the long rear fuselage devoid of metal to improve performance of the MAD stinger in the extended tailcone. It cannot be accounted for merely by the weight, under the forward fuselage, of the surveillance radar, which resembles that of some Ka-25 helicopters. The absence of wing pylons is noteworthy. Crew is reported to number 12, eight being mission operators in the main tactical compartment. Production was probably about 100, completed in the early 1970s. In 1972 several operated from Egypt, and in 1979 Il-38s (called **'May'** by NATO) operated from the Yemen. India bought three ex-AV-MF (Soviet navy) aircraft, which fly from Goa with No. 315 Sqn.

Like its slightly earlier contemporary, the Orion, the Il-38 was evolved from a civilian airliner. Some 60 are believed to be operational with the Soviet navy and can be found over the Atlantic, Mediterranean and, increasingly, over the Indian Ocean. Three ex-Soviet models are in Indian service.

Specification

Il-38 'May'
Type: maritime patrol and ASW aircraft
Powerplant: four 3169.2-ekW (4,250-ehp) Ivchenko AI-20M turboprops
Performance: (estimated) cruising speed 645 km/h (401 mph); range 7250 km (4,505 miles)
Weights: (estimated) empty 36300 kg (80,028 lb); maximum take-off 64000 kg (141,096 lb)
Dimensions: 37.40 m (122 ft 8.4 in); length 39.60 m (129 ft 11.1 in); height 10.17 m (33 ft 4.4 in); wing area 140.0 m^2 (1,507.0 sq ft)
Armament: not known, but certainly includes numerous sonobuoys and AS torpedoes housed internally; wing hardpoints have been reported but remain unconfirmed

Iraq

For centuries Iraq has been one of the most turbulent of all the nations in the Middle East, and has been beset by a tradition of internal unrest and an aggressive foreign policy. Historically, military action has followed a cycle of victory and then defeat leading to expansion followed by occupation, and the nature of the population is such that it has a reputation for ungovernability. In recent years this latter problem has been partially corrected by the imposition of a rigid military autocracy leading to a period of relative stability, but for the armed forces this period has been marked by a constant war against the Kurds, a warlike minority seeking autonomy. This Kurdish war has now been going on for over 15 years but in recent times has been overshadowed by the now stalemated Iran-Iraq conflict.

Although this war has now settled down into a state of virtual immobility, it still occupies most of the Iraqi armed forces' resources and manpower. Unlike their opponents, the Iraqis do at least have the advantage that their armed forces are still in a cohesive state and new weapons and supplies are obtainable. The air force is still active and the small navy is still operating. However the Iraqis simply lack the strength to overcome their opponents who are still numerically superior, in men if not in matériel. When Iraq invaded Iran back in September 1980 all went well, though only at first. The subsequent Iranian counteroffensives pushed the Iraqis back into Iraqi territory, but the two sides are now unable to make any marked impact upon each other. Iran has already resorted to chemical warfare in an attempt to make a breakthrough and the Iraqis are currently using their air force to attack the oil tankers and oil installations that shore up Iran's shaky economy. Throughout this war, as in the Kurdish war, it is the Iraqi army that is bearing the brunt of the fighting, and to date casualties have been heavy (but virtually impossible to quantify). But the army, like the air force and navy, remains a cohesive body.

The Iraqi Army

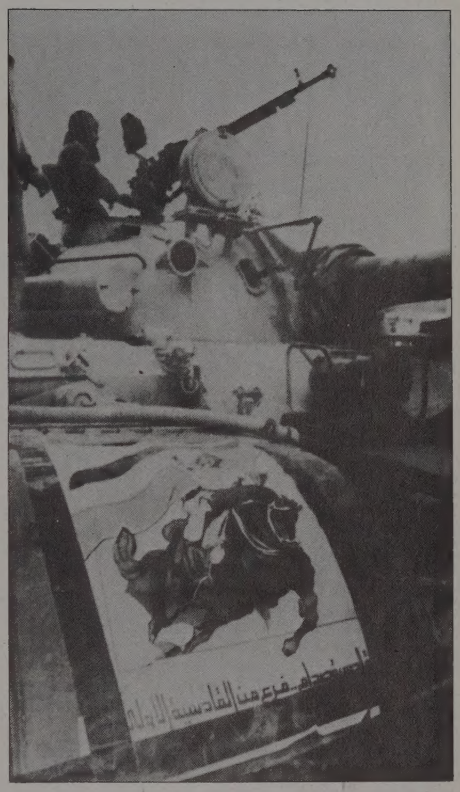
At any one time the Iraqi army is some 475,000 strong, the very great majority of these men being conscripts. Conscripts normally serve a two-year term, but the war has meant that many have to remain in uniform much longer. Many of the army's reserves of 100,000 men have also been recalled for service. The army is organized into a number of corps, four in all, made up from six armoured divisions, four mechanized infantry divisions and six infantry and mountain divisions. There are also two Republican Guard armoured brigades, mainly retained for the personal use of the president, and three special-forces brigades which, as their name implies, are used for purposes such as behind-the-line operations or airborne missions. There are nine reserve brigades, and to these can be added 15 People's Army and other volunteer infantry brigades, not all of which are for front-line use.

In recent years Iraq has deliberately tried to get away from a reliance on the Soviet Union for all arms supplies, but the army is still largely equipped with Soviet weapons. There are over 2,100 tanks in service including T-54, T-55, T-62 and T-72 main battle tanks (MBTs). To these can be added about 100 PT-76 amphibious tanks and an undefined number of ex-Chinese T-69 tanks. Captured equipment has also been impressed for use (including numbers of Chieftain MBTs), and other equipment has been passed to Iraq by supportive Arab nations such as Kuwait. Other armour includes virtually the entire range of Soviet armoured personnel carriers and light armoured vehicles, but in recent years more have arrived from Brazil. Brazil is now one of Iraq's major weapon suppliers and in Iraqi service are EE-3 armoured cars, EE-9 Cascavel light armoured vehicles and EE-11 Urutu armoured personnel carriers. Other equipment has come from France (Panhard M-3 armoured cars) and Switzerland (MOWAG wheeled armoured vehicles). Czechoslovakia has been another weapons supplier.

The Iraqi artillery is a powerful arm with well over 3,500 pieces of towed and self-propelled ordnance. Most of the weapons are of Soviet origin and include large numbers of FROG rockets and even heavy mortars. Anti-tank weapons include Soviet guns, Austrian tank destroyers and missiles including the Soviet 'Sagger', French SS.11, HOT and Milan, and British Swingfire weapons. Air defence weapons include all the usual Soviet missiles, large and small, along with numbers of Soviet anti-aircraft guns. As with the armour, many ex-Iranian weapons are in service.

The main point to bear in mind at the moment is that Iraq is still obtaining supplies of weapons from a number of sources while Iran is not. Weapons continue to be sent to Iraq from Brazil, France and many other nations; for example, a new weapon recently delivered by France has been the 155-mm (6.1-in) GCT self-propelled gun. Many Arab nations support Iraq in the conflict with Iran, and even if they do not provide weapons they donate funds for arms purchases.

Another point to bear in mind with the Iraqi army is that it remains an organized fighting force, even after four years and more of constant war, to say nothing of the war against the Kurds that still sputters away in the mountains to the north. But set against this is the fact that the Iraqi regime is a military dictatorship that retains its hold on power to great extent by the imposition of military force. During the early days of the war with Iran many political differences were set aside and for a period even the Kurds ceased their small war, but as the war continues and no results are to be seen, the army is being used increasingly to maintain internal stability, and at times combat units have had to be withdrawn from the front for internal security duties. In theory the People's Army is used for this purpose, but the fact that it is found necessary to employ combat units for the task speaks volumes in itself.



The poster on this T-55 commemorates the great Arab victory over the Persians in 637 at Qadisiya. President Hussein gambled he could win another, but his attack stalled, embroiling Iraq in a war of attrition against a country with three times its population ruled by uncompromising fanatics.

The Iraqi Navy

The Iraqi navy is an integral part of the army, and numbers only about 4,000 men. The main naval bases are at Umm Qasr and Basra. The largest Iraqi ship is a single training frigate, the main combat strength being formed by a number of small attack craft or coastal vessels. During the war with Iran the Iraqi navy has been engaged in some spirited scraps with the Iranian navy, and has suffered accordingly in men and vessels. In time, however, these losses

Iraqi gunners pound the Iranian oil city of Khoramshahr with Russian M1931/37 (A-19) 122-mm guns. Iraq has about 3,500 guns, mostly of Soviet origin, varying from these World War II models to the latest Soviet equipment. Holding positions against Iranian human wave attacks, the Iraqi forces rely heavily on such long-range firepower.

Iraqi infantry use a bewildering variety of Soviet, French, Brazilian and, in this case, Czech APCs; these are OT-64Cs, capable of carrying up to 15 men in addition to their two-man crew. The turret mounts a 14.5-mm KPVT machine-gun with a co-axial 7.62-mm MG.

A T-62 crosses the Karoun river in October 1980, as the advance into Iran continues. Until the invasion of Iran, Iraqi tanks were more usually seen on the streets of Baghdad or surrounding the Presidential palace during the frequent coups d'état.

will be more than compensated by the arrival of four frigates and six corvettes currently on order from Italy. These will have logistical backing from a new support ship. In the meantime the main striking force of the navy is invested in about six or seven ex-Soviet 'Osa' class missile-armed fast attack craft.

The Iraqi Air Force

The Iraqi air force is a separate arm from the army, and has a numerical strength of 38,000 men, including air-defence personnel. It is still organized very much along Royal Air Force lines, a legacy of the period when the UK occupied Iraq, but much of the equipment is Soviet in origin. However, determined efforts have been made to diversify supply sources and thus some French aircraft are used along with the remaining few Hawker Hunters (and Westland Wessex helicopters) from many years back.

The Iraqi air force is one of the most powerful in the Middle East, and despite combat losses it remains an effective operational force still. It includes among its aircraft some of the most sophisticated Soviet warplanes available, and it still manages to obtain the latest types from the Soviet Union, although aircraft from France have been among the most recent aircraft arrivals; these include Dassault-Breguet Mirage F.1 fighters and the well-known combination of Dassault-Breguet Super Etendards and Exocet missiles.

A Hawker Hunter FGA.Mk 59 of the Iraqi air force is seen at Dunsfold before delivery. Iraq received its first Hunters in 1957, and large numbers of refurbished aircraft, like this ex-Belgian example, have been procured subsequently. Thanks to the British occupation of Iraq, the modern Iraqi air force owes much of its organization and doctrine to RAF practice.

The main striking force of the air force is its two bomber squadrons, one with the Tupolev Tu-22 'Blinder' and the other with venerable Ilyushin Il-28 'Beagle' bombers. Combat has cut down the numbers of these to perhaps seven and five respectively, but these two squadrons are still able to provide a powerful raiding potential. There are no fewer than 11 fighter/ground attack squadrons with a mix of Mikoyan-Gurevich MiG-23BM 'Flogger', Sukhoi Su-7 'Fitter' and Sukhoi Su-20 'Fitter' aircraft along with the few remaining Hunters. The five interceptor squadrons have an even more varied mix of MiG-19 'Farmer', MiG-21 'Fishbed' and MiG-25 'Foxbat' aircraft along with the first of the Mirage F.1s to arrive. The MiG-19s and MiG-21s come from both Soviet and Chinese sources.

The advanced MiG-25 'Foxbat' also equips a single reconnaissance squadron, and there are two transport squadrons, again with a varied mix of Antonov transports, Ilyushin Il-76 'Candid' heavy transports (including some impressed civilian examples), Ilyushin Il-14 'Crate' light transports and two Tupolev Tu-124s. More transport capability is supplied by 11 helicopter squadrons. The range of equipment used by these squadrons is wide, and covers all the usual Soviet Mil designs, French Aérospatiale Super Frelons and Gazelles, West German MBB BO105s, and the last of the ex-British Wessex helicopters.

A great deal of equipment is on order for the air force, some of it combat replacements, but much of it new. A portion of this new equipment, including missiles, is already to hand and has been used in action against the Iranian oil installations and tankers in the Persian Gulf. The Iraqi air force at present has air superiority over the remains of the Iranian air force, and as supplies of new matériel continue to arrive it seems set to retain this superiority for some time to come. It has certainly been one of the major reasons why the Iranian army is unable to use its manpower to 'steamroller' through the Iraqi army lines.

Order of battle

Iraqi Army

6 armoured divisions (T-54, T-55, T-62, T-72 and Chieftain MBTs, PT-76 light tanks, and numerous armoured car types)
4 mechanized infantry divisions (BRDM, FUG-70, ERC-90, MOWAG, EE-9 and EE-3 armoured cars, and BMP, BTR-50, BTR-60, BTR-70, OT-62, OT-64, Panhard and EE-11 APCs)
6 infantry and mountain divisions
2 Republican Guard armoured brigades
3 special forces brigades
9 reserve brigades (mostly infantry)
15 People's Army and volunteer brigades
various security troops
some 10,000 volunteers from other Arab countries

Iraqi Navy

1 training frigate
8 'Osa' missile attack craft
3 'SO-1' large patrol craft
6 'P-6' torpedo attack craft
6 coastal patrol craft
5 'T-43' minesweepers
3 tank landing craft

Iraqi Air Force

2 bomber squadrons (Tu-22 'Blinder' and Il-28 'Beagle')
11 fighter/ground attack squadrons (MiG-23BM 'Flogger', Su-7 and Su-20 'Fitter', and Hunter)
5 interceptor squadrons (MiG-25 'Foxbat', MiG-19 'Farmer', MiG-21 'Fishbed' and Mirage F.1)
1 reconnaissance squadron (MiG-25 'Foxbat')
2 transport squadrons (An-2 'Colt', An-12 'Cub', An-24 'Coke', An-26 'Curl', Il-76 'Candid', Il-14 'Crate' and Tu-124 'Cookpot')
11 helicopter squadrons (Mi-4 'Hound', Mi-6 'Hook', Mi-8 'Hip', Mi-24 'Hind', Alouette III Super Frelon, Gazelle, Puma, BO105 and Wessex)